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LAKE ERIE WATER LEVEL STUDY. APPENDIX G. RECREATIONAL BEACHES A--ETC(U)

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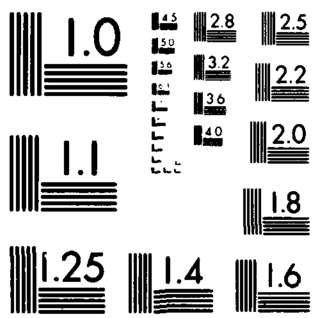

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NATIONAL BUREAU OF STANDARDS 1963-A

Lake Erie Water Level Study

Recreational Beaches and Boating

International Lake Erie Regulation Study Board

International Joint Commission

July 1981

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A114591	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Lake Erie Water Level Study, Appendix G, Recreational Beaches and Boating		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS International Lake Erie Regulation Study Board		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Buffalo 1776 Niagara Street Buffalo, N.Y. 14207		12. REPORT DATE July 1981
		13. NUMBER OF PAGES 262
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Distribution Unlimited

DTIC ELECTE MAY 19 1982 S H D

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Beaches, Recreational Boating, Lake Regulation, Water Levels, Great Lakes

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Recreational Beaches and Boating Appendix describes the effects of limited regulation of Lake Erie on recreational beaches and boating in the lower Great Lakes-St. Lawrence River system.

This evaluation was limited to Lakes Erie and Ontario and part of the St. Lawrence River where the impact was expected to be greatest and due to time and funding constraints. Also, due to these constraints, the study of the

(continued on reverse side) next page

20. effects on recreational boating was confined only to United States waters.

Limited regulation of Lake Erie would have the effect of lowering the water level of that lake and those upstream. As a result, there would be losses to recreational boating, with the losses dependent upon the amount of lowering. At the same time, recreational beaches would benefit due to increases in beach area.

APPENDIX G

RECREATIONAL BEACHES AND BOATING

LAKE ERIE REGULATION STUDY

REPORT

TO THE

INTERNATIONAL JOINT COMMISSION

BY THE

INTERNATIONAL LAKE ERIE REGULATION

STUDY BOARD

(UNDER THE REFERENCE OF 21 FEBRUARY 1977)

JULY 1981

SYNOPSIS

The Recreational Beaches and Boating Appendix describes the effects of limited regulation of Lake Erie on recreational beaches and boating in the lower Great Lakes-St. Lawrence River system.

Limited regulation of Lake Erie would require increasing the outflow during periods of above-average water supplies to the upper Great Lakes, i.e., Lakes Superior and Michigan-Huron. The purpose is to lower the extreme high water levels on Lake Erie so as to reduce shoreline flood and erosion damages. Regulation plans for limited regulation of Lake Erie were developed and tested over the period 1900-1976. The effects of limited regulation of Lake Erie were identified by comparing the water levels and outflows that would have occurred under regulated conditions, with the water levels and outflows under present Lake Erie outlet conditions. The effects were expressed in monetary terms for a project life of 50 years.

All losses and benefits were based on July 1979 price levels, using an interest rate of 8-1/2 percent. The study was limited to Lakes Erie and Ontario and part of the St. Lawrence River where the impact was expected to be greatest and due to time and funding constraints. Also, due to these constraints, the study of the effects on recreational boating was confined only to United States waters.

Limited regulation of Lake Erie would have the effect of lowering the water level of that lake and those upstream. As a result, there would be losses to recreational boating, with the losses dependent upon the amount of lowering. Overall, the losses in terms of present value would range from \$5 million for Plan 6L to about \$36 million for Plan 25N. At the same time, recreational beaches would benefit due to increases in beach area. The combined benefits in terms of present value to Canada and the United States would range from about \$9 million for Plan 6L to about \$71 million for Plan 25N.

COVER PHOTO: Aerial view of marina and beach at Bayfield, Ontario on Lake Huron, May 27, 1978. Norman A. Rukavina.

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APPENDIX A - LAKE REGULATION

A detailed description of the various factors which govern the water supply to the Great Lakes-St. Lawrence River System and affect the response of the system to this supply along with documentation of the development and hydrologic evaluation of plans for limited regulation of Lake Erie.

APPENDIX B - REGULATORY WORKS

A description of design criteria and methods used and design and cost estimates of the regulatory and remedial works required in the Niagara and St. Lawrence Rivers to facilitate limited regulation of Lake Erie.

APPENDIX C - COASTAL ZONE

A documentation of the methodology developed to estimate in economic terms the effects of changes in water level regimes on erosion and inundation of the shoreline and water intakes and of the detailed economic evaluations of plans for limited regulation of Lake Erie.

APPENDIX D - COMMERCIAL NAVIGATION

A documentation of the methodology applied in the assessment of the effects on shipping using the Great Lakes-St. Lawrence navigation system as a consequence of changes in lake level regimes and the evaluation of the economic effects on navigation of regime changes that would take place under plans for limited regulation of Lake Erie.

APPENDIX E - POWER

A documentation of the methodology applied in the assessment of the effects of hydro-electric power production at installations on the outlet rivers of the Great Lakes and of the detailed economic evaluation of the effects of plans for limited regulation of Lake Erie on the capacity and energy output of these installations.

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APPENDIX F - ENVIRONMENTAL EFFECTS

A documentation of the qualitative assessment of the effects of plans for limited regulation of Lake Erie on fish, wildlife, and water quality within the lower Great Lakes and the St. Lawrence River.

APPENDIX G - RECREATIONAL BEACHES AND BOATING

A documentation of the methodology applied in the assessment of the effects of plans for limited regulation of Lake Erie on beaches and recreational boating activities, along with a detailed economic evaluation, within the lower Great Lakes and the St. Lawrence River.

APPENDIX H - PUBLIC INFORMATION PROGRAM

A documentation of the public information program utilized throughout the study to inform the public of study activities and findings and provide a vehicle for public comment on the study.

Section 1

INTRODUCTION

1.1 General

As a result of a recommendation in the International Joint Commission's 1976 Report to the Governments of Canada and the United States, entitled "Further Regulation of the Great Lakes," the Governments issued on February 21, 1977 a reference to the International Joint Commission (IJC). Pursuant to this reference, the Commission established the International Lake Erie Regulation Study Board. The Commission directed the Board to undertake a study to determine possibilities for lowering extremely high water levels by limited regulation of Lake Erie, taking into account the applicable Orders of Approval of the Commission and the recommendations of the Canada-Quebec study of flow regulation in the Montreal region. As part of the study, the Board examined a broad spectrum of regulation-related economic, social, and environmental effects of limited regulation throughout the Great Lakes Basin, including the International and Canadian Reaches of the St. Lawrence River.

Any modification to the outflows of Lake Erie would affect a portion of the supply of water to Lake Ontario and, to some extent, affect the levels and outflows of the upper Great Lakes. In this regard, the Board evaluated three regulation categories. Categories 1 and 2 consider Lake Erie regulation constrained by the present Orders of Approval and channel limitations of the St. Lawrence River. Category 3 considers channel modifications and/or remedial measures in the St. Lawrence River to accommodate regulation of Lakes Erie and Ontario. A more detailed description of the three regulation categories is presented in Appendix A, Lake Regulation. The Commission further directed that if the Board finds that new or altered regulatory works or other measures would be practical, it should estimate their costs, and the effects, whether beneficial or adverse, on the various interests. The interests included those evaluated economically (coastal zone, commercial navigation, hydroelectric power, and recreational beaches and boating) or environmentally (water quality, wildlife/wetlands, and fish). The economic evaluation of the effects of limited regulation of Lake Erie on recreational beaches and boating interests is the subject of this Appendix.

The customary (British) units of measurements are used in this appendix. A British to Metric conversion factor table is contained in Annex A.

1.2 Scope

In order to evaluate the effects of limited regulation of Lake Erie on recreational beaches and boating interests, the regime of water levels and flows pertinent to the investigation were defined. A description of the level and flow characteristics evaluated is contained in Section 2. Sections 3 and 4 describe in detail the evaluations of beaches and boating, respectively. Included in the description are the assumptions and equations used in the evaluation methodologies.

The geographic scope of the evaluations was limited to the lower Great Lakes and their connecting rivers because of time and funding constraints. The study area extended from Port Huron, Michigan-Sarnia, Ontario, to the New York State-Province of Quebec border; an area containing Lakes St. Clair, Erie, and Ontario, and the St. Clair, Detroit, Niagara, and St. Lawrence Rivers.

All data used during the evaluations, including contributory reports, are filed at the following agencies in Canada and the United States:

Water Planning and Management Branch
Inland Waters Directorate
Environment Canada
P.O. Box 5050
Burlington, Ontario, Canada L7R 4A6

Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York, USA 14207

1.3 Study Organization

The Working Committee, established by the International Lake Erie Regulation Study Board, created several subcommittees to evaluate the impacts that would result from limited regulation of Lake Erie. Although considered part of the Environmental Effects Subcommittee throughout the Study, the recreational beaches and boating group functioned as a separate entity since its evaluations were quantitative rather than qualitative as for the other "environmental" groups (water quality, wildlife/wetlands, and fish). The recreational group was comprised of personnel from the U.S. Army Corps of Engineers, the Ontario Ministry of Natural Resources, and Canadian Department of Fisheries and Oceans. A list of participants is contained in Annex B.

1.4 Prior Studies

The International Great Lakes Levels Board (IGLLB) Study included the evaluation of recreational beaches and boating. Appendix D - Fish, Wildlife, and Recreation, dated December 7, 1973, of the IGLLB Study contains a description of the evaluation. The information contained in the IGLLB report was used wherever applicable in the Lake Erie Regulation Study. Much of the background data, however, is no longer available and it was therefore necessary to undertake an inventory of beaches and boating facilities. The inventory was along the U.S. shoreline only, since Canadian beach data was readily available and Canadian boating data, although not available, was not collected because of financial constraints. Because of the lack of Canadian boating data, no attempt was made in this study to evaluate possible impacts on this interest.

Section 2

REGULATION PLAN EFFECTS ON WATER LEVELS/FLOWS IN THE LOWER GREAT LAKES

2.1 General

The basis-of-comparison and all three regulation plans (25N, 15S, and 6L) have the potential for affecting the long-term annual mean water level, the extreme high and low water levels as well as their frequency of occurrence and duration, and the long-term water level fluctuation range and, thereby, would affect recreational activities.

2.2 Basis-of-Comparison

The basis-of-comparison and adjusted basis-of-comparison represent the water levels and outflows that the Great Lakes would have experienced for the study period 1900-1976 under certain assumed conditions. They also portray water levels which could occur in the future if the Great Lakes were to experience supplies similar to those received during the period 1900-1976. The basis-of-comparison levels, therefore, are distinctly different from the historical 1900-1976 water levels. They are anticipated future levels forming a basis from which deviations caused by the regulation plan could be measured and evaluated. The historical conditions which occurred during the 77-year period have been used only as indicators of how recent conditions have shaped the existing environment.

Appendix A, *Lake Regulation*, and Section 3 of the Main Report provide detailed descriptions of the development of the basis-of-comparison and adjusted basis-of-comparison. Table G-1 is a summary of the hydrologic evaluation of Lake Erie regulation plans.

Limited regulation of Lake Erie would require construction of regulatory works near the head of the Niagara River. These works would be operated, when required, to permit additional Lake Erie outflows. Their capacities range from low, such as Plan 6L which uses the Black Rock Lock, to high, such as Plan 25N which uses the Niagara River structure.

2.3 Lakes Erie and St. Clair

2.3.1 Plan 25N

Plan 25N would require a control structure in the Niagara River that would provide an additional outflow capacity of 25,000 cfs. Plan 25N would lower the mean level of Lake Erie by about 7 inches. It would have the most dramatic effect of all the plans on water levels. The plan would increase the frequency of occurrence of low levels (569.7 feet and below). The plan would also reduce the frequency of high levels but would not produce any noticeable changes in the seasonal water level pattern.

Table G-1 - Summary of Hydrologic Evaluation of Lake Erie Regulation Plans

	Basis-of-Comparison	Plan 6L	Plan 15S	Plan 25N
LAKE SUPERIOR				
Mean	600.44	600.43	600.41	600.37
Maximum	601.93	601.93	601.93	601.93
Minimum	598.69	598.68	598.65	598.62
Range	3.24	3.25	3.28	3.31
LAKES MICHIGAN-HURON				
Mean	578.27	578.24	578.18	578.05
Maximum	581.15	581.09	580.99	580.75
Minimum	575.47	575.45	575.42	575.36
Range	5.68	5.64	5.57	5.39
LAKE ERIE				
Mean	570.76	570.67	570.53	570.17
Maximum	573.60	573.45	573.18	572.53
Minimum	568.09	568.07	568.02	567.84
Range	5.51	5.38	5.16	4.69
LAKE ONTARIO - Cat. 1 (with deviation)				
Mean	244.61	244.64	244.65	244.63
Maximum	247.37	247.39	247.56	247.50
Minimum	241.81	241.74	241.59	241.38
Range	5.56	5.65	5.97	6.12
LAKE ONTARIO - Cat. 2				
Mean	244.61	244.66	244.69	244.71
Maximum	247.37	247.34	247.42	247.45
Minimum	241.81	242.04	242.12	242.21
Range	5.56	5.30	5.30	5.24
	Adj. BOC	**Plan 6L**	**Plan 15S**	**Plan 25N**
LAKE ONTARIO - Cat. 3				
Mean	244.63	244.64	244.65	244.67
Maximum	246.77	246.79	246.84	246.83
Minimum	242.38	242.32	242.34	242.47
Range	4.39	4.47	4.50	4.36

For the high water period (1971 to 1976) the plan would reduce the Lake Erie mean level averaged for those years by about 12 inches and the maximum June mean level also by about 12 inches. During the low water period (1961-1966) this plan would lower the mean level for Lake Erie by 4 inches and the minimum February mean level also by 4 inches. The duration of low water periods would be increased.

On Lake St. Clair, Plan 25N would lower the mean level by 5 inches. For the low water years (1961 to 1966) the plan would reduce the Lake St. Clair mean level for the period by about 3 inches.

2.3.2 Plan 15S

Plan 15S would require a Black Rock Canal-Squaw Island Diversion Channel structure to increase the outflow capacity by about 10,000 cfs. Plan 15S would lower the Lake Erie mean level by about 3 inches. During the high water period (1971-1976) this plan would reduce the Lake Erie mean level for the period by about 4 inches and the maximum June level by about 5 inches. It would reduce the frequency of occurrence of high levels but it would also increase the frequency of occurrence of low levels. During low water years (1961-1966) the plan would lower the Lake Erie mean and minimum levels by about 2 inches. For Lake St. Clair, the long-term mean level would be lowered by about 2 inches.

2.3.3 Plan 6L

Plan 6L would require modifications to the existing Black Rock Navigation Lock to provide the outflow capacity of about 4,000 cfs. Plan 6L would lower the Lake Erie mean level by about 1 inch. There would be slight changes in the frequency of occurrence of high and low water levels.

2.4 Lake Ontario

On Lake Ontario, the long-term mean water level would not change much under Category 1. For Category 2 plans, they would be increased slightly. Compared to the adjusted basis-of-comparison, Category 3 plans would also raise slightly the mean level. All three plans would increase the frequency of occurrence of high levels. All plans under Category 1 would lower the minimum water levels, an effect which was particularly noticeable during the extended low period (1961-1966). The long-term fluctuation range would be increased slightly for all plans under Category 1.

Section 3
BEACHES

3.1 Introduction

3.1.1 Study Area

The study area encompassed the shoreline of the lower Great Lakes and connecting channels from Port Huron, Michigan-Sarnia, Ontario, downstream to Cornwall, Ontario-Massena, NY, on the St. Lawrence River. Figure G-1 shows the reaches or shoreline segments along Lakes St. Clair, Erie, and Ontario, and the St. Clair, Detroit, Niagara, and St. Lawrence Rivers. The Canadian reaches correspond to the boundaries of the administrative districts of the Ontario Ministry of Natural Resources on a lake-by-lake basis. For the United States, the reaches are the same as those used by the International Great Lakes Levels Board (IGLLB).

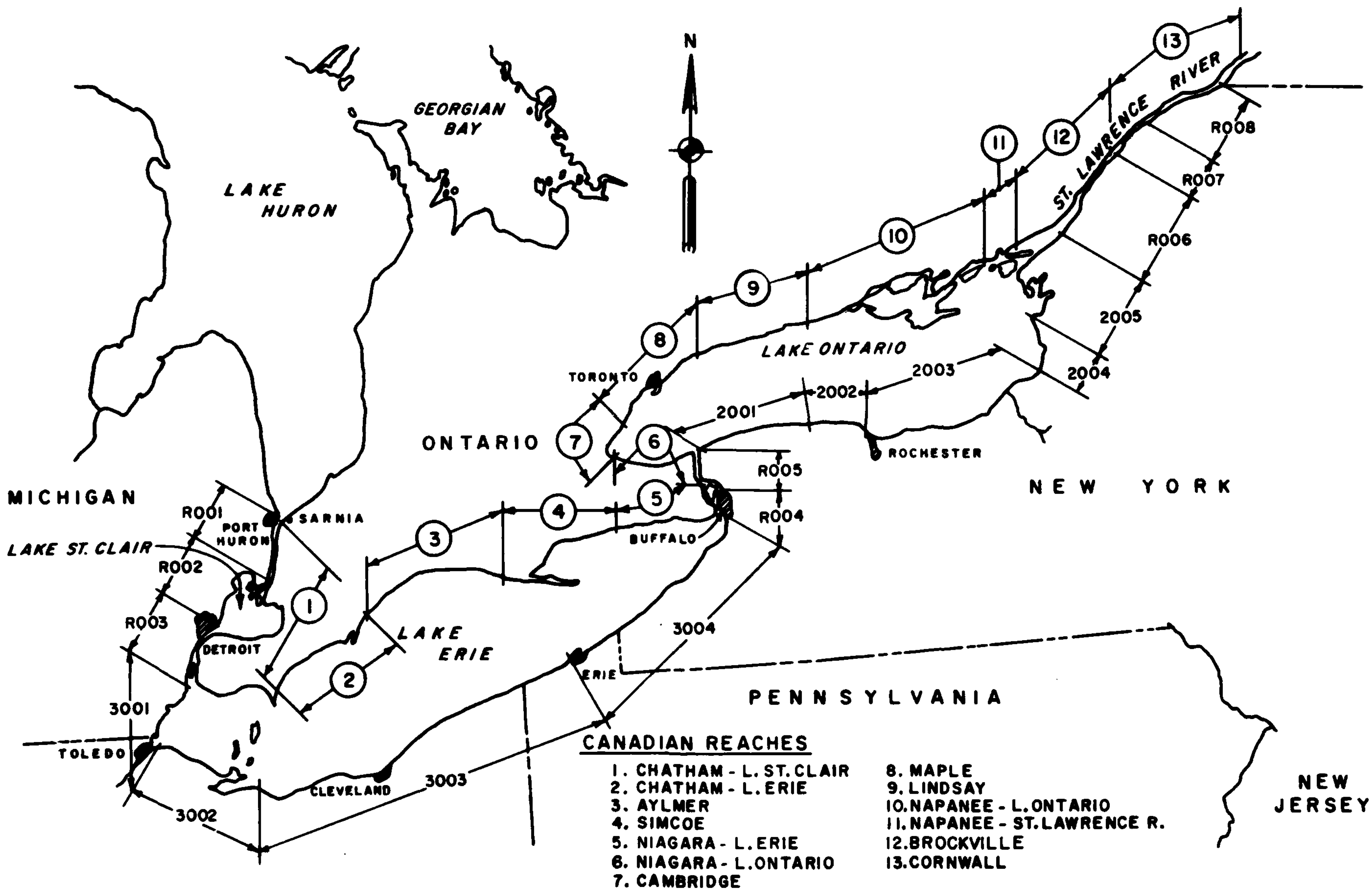
A significance test was made to ascertain whether there would be any impacts of regulation on the Canadian beaches of Lake Huron. Although test results indicate that the impacts would be significant (Annex C), these beaches were not included due to time and financial constraints of the study.

Beaches along the Canadian portion of the St. Lawrence River were not included since accurate water level data by beach were not available.

3.1.2 Existing Conditions

Approximately 80 miles, or 4 percent of shoreline in the study area, are publicly accessible recreation beaches (U.S.: 27 percent; Canada: 73 percent). Many of these beaches are of high quality and provide a wide range of recreational beach activities. Some examples include: Rondeau, Long Point, and Sandbanks in Canada and Hamlin (New York), Presque Isle (Pennsylvania), and Cedar Point (Ohio), in the United States.

A summary of beach physical characteristics is presented in Table G-2. Lake St. Clair, including St. Clair River beaches, contains 1.3 miles (U.S. 63 percent, Canada 37 percent). Lake Erie, including Detroit and Upper Niagara River beaches, contain 43 miles (U.S. 38 percent, Canada 62 percent). Lake Ontario, including the Lower Niagara River beaches, 34 miles (U.S. 12 percent, Canada 88 percent), and St. Lawrence River beaches 3.8 miles (U.S. 17 percent, Canada 83 percent). Beach areas were determined using long-term seasonal mean water levels under basis-of-comparison conditions.



BEACH REACHES IN THE STUDY AREA

FIGURE G-1

Table G-2 - Beaches in the Study Area

Waterbody	Reach	Beaches Length (feet)	Beaches Area 1/ (sq. feet)
Lake St. Clair (includes St. Clair River)			
Canada	Chatham (LSt.C)	4,462	
United States	R001	0	0
	R002	2,575	298,800
			298,800
Total		7,037	
Lake Erie (includes Detroit River & Upper Niagara River)			
Canada	Chatham (LE)	55,406	
	Aylmer	13,471	
	Simcoe	31,409	
	Niagara (LE)	39,809	
Subtotal		140,095	
United States	R003	1,094	143,200
	3001	1,010	193,800
	3002	8,696	838,400
	3003	30,032	2,955,900
	3004	42,674	5,076,100
	R004	2,020	298,600
Subtotal		85,526	9,506,000
Total		225,621	
Lake Ontario (includes Lower Niagara River)			
Canada	Niagara River(LO)	15,533	
	Cambridge	15,800	
	Maple	46,468	
	Lindsey	19,762	
	Napanee (LO)	58,226	
Subtotal		155,789	
United States	R005	0	0
	2001	4,608	420,000
	2002	5,130	717,300
	2003	6,096	730,500
	2004	4,524	426,400
	2005	1,537	72,100
Subtotal		21,895	2,366,300
Total		177,684	
St. Lawrence River			
Canada	Napanee (SLR)	3,510	
	Brookville	4,494	
	Cornwall	8,771	
Subtotal		16,775	
United States	R006	1,074	62,200
	R007	0	0
	R008	2,405	332,200
Subtotal		3,479	394,400
Total		20,254	
Study Area			
Canada		317,121	
United States		113,475	12,565,500
Total		430,596	

1/ Areas for Canadian beaches were not determined

3.2 Evaluation Procedure

3.2.1 General

Recreational beach opportunities were determined, and benefits or losses resulting from regulation were calculated by comparing projected recreational beach use.

Swimming is an activity indicator for beach use. The amount of this activity was based on dry beach area converted to recreational beach opportunities. Beach area, then, is the measure that is affected by fluctuating water levels. Changes in lake level due to regulation would result in changes in beach area which can be converted to changes in opportunities available.

A basic assumption of this study is that no benefit or loss will occur if the additional recreational beach supply due to regulation is not needed to satisfy projected use. That is, if supply resulting from regulation is greater than supply without regulation then benefit due to regulation will occur; if the former is equal to the latter, then there is no effect; or, if the former is less than the latter, then a loss results due to that regulation scheme.

Each unit of supply is expressed in monetary terms, hence benefits or losses resulting from the regulation plans are expressed in dollars.

3.2.2 Supply

In general, supply is calculated by multiplying the number of days which are available for swimming by the number of people which can be physically accommodated on a beach in any one day. This calculation makes no allowance for the presence or absence of support facilities such as parking spaces or concessions, nor does it reflect varying quality of experience; the only study variable is beach area as affected by changes in water level.

The formula used to determine supply is:

$$\text{Supply} = \begin{array}{c}\text{area of}\\\text{beach}\end{array} \times \begin{array}{c}\text{space}\\\text{standard}\end{array} \times \begin{array}{c}\text{turnover}\\\text{rate}\end{array} \times \begin{array}{c}\text{number of}\\\text{suitable days}\end{array} \times \begin{array}{c}\text{peaking}\\\text{factor}\end{array}$$

Supply is expressed in opportunities (the number of specified opportunities of an activity provided by a facility over a time period is equal to the number of occasions that the facility can accommodate).

Selection of Canadian Beaches: The Canadian beach survey, called the Ontario Recreation Supply Inventory (ORSI), makes certain selections as to which beaches are actually measured.

The survey included a questionnaire which was to be completed for all beaches used for swimming and sunbathing open to the general public on a

daily basis, or part of private clubs, youth camps, resorts, or other commercial accommodation establishments. Only those beaches having all of the following characteristics were to be inventoried:

1. There must be a wet beach at least 5 metres wide (to a depth of 1.5 metres, i.e., 5 feet);

2. the wet beach material must be sand, gravel, or smooth rock;

3. there must be some backshore presently usable by swimmers. The backshore does not necessarily have to be sand; and

4. the beach must be accessible by land or by publicly-available boat (e.g., Toronto Islands). This means that all beaches accessible only by private boat are to be excluded.

On rare occasions, it was impossible to record all information on a single activity site questionnaire; e.g., two swimming areas, one with a wet beach of sand, another with a wet beach of gravel. In such cases, a second beach questionnaire was required. However, such situations were the exception, not the rule. The average backshore and wet beach widths were taken. If a width criterion was the only difference, two questionnaires were not necessary.

Regarding the access criterion, only those beach areas within 400 metres (1/4 mile) of driveable road access were inventoried (i.e., a beach length that is 400 metr beyond a road was excluded). This limit was chosen because most people are not willing to walk more than 400 metres from their transportation to engage in beach activities.

Within the study area, this circumstance occurred 10 times; eight in Roudeau Provincial Park and twice in Point Pelee National Park representing 2.7 percent of the total number of beaches surveyed.

Beach length is provided accurately by the inventory. Width, of course, varies with a change in water level. The width measurement used is also provided by ORSI, but is, unfortunately, grouped into width classes. Table G-3 shows the distribution of width classes by waterbody. The midpoint of the class was used as a substitute for the actual measurement.

Table G-3 - Distribution of Canadian Beach Width Classes by Lake and Interconnecting Channel

Waterbody	Number of Beaches Per Width Class: Less than 5m	5-10m	10-20m	20-40m	40-80m	Greater than 80m	Total	Percent of Total
Lake St. Clair (includes St. Clair River)	4	6	9	1	-	3	23	6.2
Lake Erie (includes Detroit and Upper Niagara River)	21	19	40	17	19	10	126	33.8
Lake Ontario includes Lower Niagara River)	38	57	38	19	14	4	170	45.6
St. Lawrence River	2	13	20	13	5	1	54	14.5
Total	65	95	107	50	38	18	373	100.0

Slope is assumed to be constant for individual beaches. ORSI provided the data to calculate the slope which was then used to convert changes in water level into the area of beach exposed or flooded. This is the wet beach measure that is the area between the shoreline and the 1.5 metre (5 feet) water depth contour line.

Selection of United States Beaches: The United States beach survey was performed by the Midwest Research Institute and included all beaches in the Lower Great Lakes study area--both those available for public use and those that were limited to private membership, for example, religious organizations and clubs. Only the publicly accessible beaches, however, were considered in the study results including private beaches open to the public for a fee; state, city, and local parks; as well as, beaches available to residents of a particular town or village. For the United States beaches, full length and width measurements were taken, regardless of how far the extremity of the beach was from the nearest access road.

Area of Beach: In Canada, beach length and width were provided by ORSI. The data used for this study were collected from 1974 to 1979.

In the United States, lengths, widths, wet beach slopes, and dry beach slopes were measured, and beach areas determined. The time and day of these measurements were recorded and the closest gage reading was noted. Measurements and statistics by reach are presented in Annex D.

Space Standard: This factor is a measure of the space required to accommodate individuals on a beach. It varies depending on the type of

experience that is intended. The standard used for this study is one person per 100 ft.^{2}. This standard has been adopted by the Ontario Ministry of Natural Resources for beaches in natural environment class provincial parks. A similar standard is used by several other jurisdictions across North America, including the Water Resources Council, and therefore is thought to be reasonable for this study. While tending to be conservative, the standard is appropriate given the range of intensities of beach use across the study area.

Turnover Rate: This factor is the number of times that the same area of beach can provide an opportunity of recreation in a day. It is calculated by dividing the total daily attendance by the peak instantaneous attendance. The rate used was 1.2 and is consistent with ORSI and current provincial park standards as supported by recent park visitor surveys and the standards used by the Corps of Engineers in U. S. beach studies.

Number of Suitable Days: The number of days suitable for swimming varies from month to month depending on the number of days in the month and the probability of cloud cover, precipitation, and suitable water and air temperatures. The Tourism and Outdoor Recreation Climate of Ontario was the source of the data used for determining the number of suitable days in Canada. Suitable days calculations are by reach and are consistent with observed recreational practices (Table G-4). The number of suitable days also defines the limits of the beach use season from May to September inclusive.

Peaking Factor: The peaking factor is used in the supply equation to adjust the number of available opportunities by known or estimated use patterns. This adjustment is necessary for comparing the total number of opportunities in a given month of recreational use with the projected use.

In Canada, this factor is called the institutional constraint factor. Institutional constraint accounts for the fact that beach supply is not equally available to all people every day of the week due to "institutional" influences such as the conventional work day and work week. It has the effect of leveling out the fluctuation of actual supply which occurs in a week due to these constraints.

The Institutional Constraint Factor (K) takes into consideration the peaking in recreational use caused by such constraints as: the days of the week people normally have off, statutory holidays, No Sunday hunting laws, etc., and, therefore, recognizes the fact that the supply of recreational opportunities is not always equally available throughout the week. In general, it has been found that for those facilities and resources which are local, and, therefore, readily accessible by foot or by bicycle, and for those facilities and resources used on an extended trip basis, K will have a value approaching 1.0. On the other hand, those facilities and resources which are regional in nature, require the use of a car as a means of transportation to the site, and are considered to be day-use recreation areas, will have a relatively low value for K.

Table G-4 - Number of Days Suitable for Month
(Canadian Suitable Days)

Administrative District/Reach	Park (Beach)	May	June	July	August	September	Total
Chatham/Lake St. Clair	Windsor	5.7	14.5	19.0	19.1	12.7	71.0
Chatham/Lake Erie	Point Pelee	4.3	14.9	19.3	19.4	13.0	70.9
	Rondeau Park	3.7	13.8	19.0	18.8	11.3	66.6
Aylmer	Port Stanley	3.8	14.1	18.6	18.3	10.3	65.1
Simcoe	Long Point Park	1.5	12.6	18.9	18.7	9.8	61.5
Niagara/Lake Erie	Rock Point Park	2.0	13.3	18.7	18.1	9.3	61.4
Lake Erie Avg.							65.1
Niagara/Lake Ontario	Niagara Falls	4.6	14.5	18.6	17.3	10.6	65.6
	Niagara-on-the-Lake	3.4	12.7	18.8	16.7	9.4	61.0
Cambridge	Hamilton	3.2	12.2	18.7	16.4	8.9	59.4
Maple	Toronto Island	1.2	9.6	17.3	15.5	6.5	50.1
Lindsay	Cobourg	1.3	10.0	17.6	15.1	6.4	50.4
Napanee/Lake Ontario	Trenton	2.2	9.6	17.3	15.7	6.6	51.4
	Outlet Beach Park	1.0	8.8	17.1	14.7	5.5	47.1
Lake Ontario Average							55.0
Napanee/St. Lawrence Rvr.	Kingston	2.4	11.0	17.5	15.8	6.9	53.6
	Brockville	4.5	12.8	17.9	16.0	7.9	59.1
Cornwall	Morrisburg	3.9	13.1	17.8	15.7	7.8	58.3
	Cornwall	4.0	13.0	17.6	15.7	7.8	58.1
St. Lawrence River Avg.							57.3

The basis for K is the comparison of attendance for a particular day of the week with the attendance on the peak day of the week (usually Sunday). If all attendance were evenly distributed throughout the week, K would equal 1.0. If all attendance were to occur on a particular day, K would equal 0.14. The following procedure was followed to determine K:

1. The average attendance for each day of the week based on the normal operating season attendance records was determined;

2. the average daily attendance, for each of the 7 days, was divided by the highest average daily attendance (usually Sunday), producing a "Daily K" for each day of the week;

3. the sum of the "Daily K's," divided by 7, is equal to K.

Table G-6 shows the Institutional Constraint Factors for Canadian reaches. Details of the calculations are given in Annex E.

Actual attendance records for U.S. beaches are not available so that an equivalent institutional constraint factor could not be calculated. A factor was developed for the United States supply equation which provides similar results. It is an established fact that most recreational use occurs on weekends, and summer holidays. With limited use of beaches on weekdays, a change in beach area caused by lake level regulation would have little effect at these times. Thus, it was assumed that benefits can be attained only on peak days when the existing, available beach is entirely used (see Table G-5).

Table G-5 - Peak Days Per Month for U.S. Supply Equation

Month	No. Days in Month	No. Weekend Days/Month	Holidays	Peak Days/ Month
May	31	8.9	1	9.9 1/
June	30	8.6	-	8.6
July	31	8.9	1	9.9
August	31	8.9	-	8.9
September	30	8.6	1	9.6

1/ Peak days are defined as weekend days and holidays. Thus, the number of peak days in May is 2/7 X 31 = 8.9 + Memorial Day (1) = 9.9 days.

Weather Influence Factor: Of course, not all of the peak days will draw peak crowds. Rain, cold, and windy conditions and other weather phenomena will reduce the number of peak day crowds.

Table G-6 - Institutional Constraint Factor by Reach by Month

Administrative District/Reach	Park	May	June	July	August	September
Chatham/Lake St. Clair	Holiday Beach	.302	.237	.273	.277	.332
	Wheatley	.292	.229	.257	.318	.264
	Rondeau	.303	.261	.487	.400	.519
Aylmer	J. S. Pearce*					
	Port Bruce*					
	Iroquois Beach	.279	.143	.283	.324	.320
Simcoe	Long Point	.280	.237	.316	.313	.303
	Selkirk	.245	.215	.271	.327	.274
Niagara/Lake Erie	Rock Point	.283	.256	.252	.353	.434
Niagara/Lake Ontario*						
Cambridge	Bronte Creek	.234	.226	.294	.316	.306
Maple*						
Lindsay	Darlington	.300	.204	.349	.319	.394
Napanee/Lake Ontario	Presquile	.429	.233	.330	.360	.324
	North Beach	.345	.350	.404	.386	.405
	Sandbanks*					
	Outlet Beach	.289	.277	.357	.387	.467
Napanee/St. Lawrence*						
Brockville*						
Cornwall*						

* No data available.

The Canadian element of the Lake Erie Regulation Study had conducted an extensive study of the number of days that peak crowds can be expected. This previous research utilizes variables such as average air temperature, percent of sunshine days, and water temperature in estimating peak days. Utilizing the Canadian Report, comparable weather influence factors were selected for aggregate reaches in the study area.1/ Essentially, the number of days available for swimming in Canadian reaches adjacent to U.S. reaches were averaged. One day was added to the average number of days available per month for U.S. aggregate reaches (generally the U.S. reaches are south of Canadian reaches and would, thus, have slightly warmer air temperatures); the U.S. number of swimming days available was then converted to a factor for use in the supply equation (percent of the month available for swimming). Weather influence factors for U.S. and Canadian reaches are given in Table G-7.

These data are from Provincial park surveys. Much of the data used in this study are from this source since this is the most reliable data available uniformly across the study area.

Considering all of the above parameters, supply at a given water level for a beach in a typical reach would, for example, be calculated as follows:

length = 325 ft.

width = 100 ft.

space standard = 100 ft^2/person

turnover rate = 1.2

days available in June for swimming = 14.1 days

peaking factor = 0.143

supply = (32,500 ft^2) x (person/100 ft^2) x 1.2 x 14.1 x 0.143

= 786 opportunities

Thus, this beach provides 786 opportunities of swimming in June.

1/ "The Effects of Proposed Lake Level Regulation on Beach Recreation Along the Lower Great Lakes," Lake Erie Level Regulation Study, 12 October 1979 (Canadian Government).

Table G-7 - Weather Influence Factor (by Reach) for U.S. Portion

Aggregate Reaches	Canadian Values: Mean No. of Days/Month	Canadian Values: Percent of Month (factor)	Selected U.S. Values: Mean No. of Days/Month	Selected U.S. Values: Percent of Month (factor)
R008 and R007 (St. Lawrence River)				
May	4.2[a]	0.135	5.2	0.168
June	13.0	0.433	14.0	0.465
July	17.8	0.574	18.8	0.606
August	15.9	0.513	16.9	0.544
September	7.9	0.263	8.9	0.295
R006, and all 2000, plus R005 (Lake Ontario)				
May	1.9[b]	0.061	2.9	0.094
June	10.4	0.347	11.4	0.380
July	17.7	0.571	18.7	0.604
August	15.6	0.503	16.6	0.535
September	7.0	0.233	8.0	0.268
R004 through 3001 (Lake Erie)				
May	2.9[c]	0.094	3.9	0.125
June	13.4	0.447	14.4	0.480
July	18.7	0.603	19.7	0.636
August	17.8	0.574	18.8	0.606
September	10.1	0.337	11.1	0.369
R003 through R001 (Detroit Area)				
May	4.1[d]	0.132	5.1	0.165
June	14.2	0.473	15.2	0.507
July	19.0	0.613	20.0	0.645
August	18.6	0.600	19.6	0.632
September	11.9	0.397	12.9	0.430

[a] Districts 9 and 10 (Brockville and Cornwall)

[b] Districts 5, 6, 7, and 8 (Cambridge, Maple, Lindsay, and Napanee)

[c] Districts 2, 3, and 4 (Aylmer, Simcoe, and Niagara)

[d] District 1 (Chatham)

Source: Canadian Government Preliminary Report

3.2.3 Projected use

A basic assumption for this study is that the current participation rate in swimming will remain the same in the future. Participation rate is defined as the number of occasions within a given time during which individuals, out of a given population, participate in various recreational activities. While appreciating that the demographic characteristics of population in the study area 20 or 50 years hence will not be the same as that currently existing, the work necessary to develop a profile of future population and then to assume certain participation patterns could not be justified in light of the limited value in refining the results of the calculation.

The Ontario Recreation Survey (ORS) conducted in 1973/74 provides the basis for projecting swimming use into the future. Survey results are thought still to be representative of the interest Ontario residents have in recreational swimming.

The State Comprehensive Outdoor Recreation Plans for New York, Pennsylvania, Ohio, and Michigan, combined with a recreational, projected use, allocation model, provide the basic input for projecting swimming use into the future for United States beaches. All States except Ohio had conducted a recent recreation survey and provided an annual basis per capita use rates for swimming in natural environments. Since a comparable rate was not available for the State of Ohio, the recent "Opportunities in the Leisure Industry" study was used as the source of data.

Canadian Method: When assigning projected use for the Canadian portion of the study, an origin-destination table was used. Projected use in destination areas, was calculated with population projections for origin areas. Table G-8 was developed using ORS, ORSI, and travel pattern data.

ORS specifies total participation in swimming for both home-based and nonhome-based trips by Ontario residents. This is expressed as "occasions" which is defined as participation in a recreational activity for any length of time during the day. The survey was based on interviews with 10,230 residents of Ontario taken from 1 May 1973 to 30 April 1974. Individuals under 12 years of age were excluded from the survey.

In the ORS, total swimming includes swimming in natural environments, i.e., beaches, as well as that which occurs in swimming pools. These total swimming figures also include swimming which occurs in nonpublicly accessible areas such as at private cottages. Since this study is concerned only with the amount of swimming taking place in each month at publicly accessible locations in natural environment settings along the Great Lakes in each administrative district, only the portion of total swimming involving natural environment areas and publicly accessible locations by month was used. It also assumed that the amount of swimming along the Great Lakes was proportional, to actual swimming supply in public, natural areas on the Great Lakes as determined in the ORSI data. As an estimate of projected use, nonresident swimming use was used as an inverse reciprocal factor. Park records, day user surveys, and the Lower Great Lakes Day Use Recreation Access Study were utilized for its calculation.

Projections of use for swimming were made for each year, using an origin-destination table (Table G-8). This table was developed on the basis of observed results specified in the ORS, assuming that this actual pattern of travel would continue into the future. Origins are the four Ministry of Natural Resources administrative regions and destinations are the 10 Ministry of Natural Resources administrative districts in Southern Ontario (Figure G-2). Table G-8 was also used to assign projected use from origin areas to supply areas.

The ORS recorded the number of occasions of swimming made by a respondent for nonhome-based swimming. In deriving the value of an opportunity, the value of the distance travelled is multiplied by the number of occasions. For nonhome-based occasions, it is not correct to assume that each occasion should be valued as if the entire distance were travelled to undertake that occasion. This matter was investigated with the following results:

1. an estimate of the number of swimming occasions generated on a weekend or vacation (i.e., nonhome-based) trip was derived (person-trip in Ontario by an Ontario resident);

2. the average number of swimming occasions generated by a weekend person-trip is 0.35;

3. the average number of swimming occasions generated by a vacation person-trip is 3.48;

4. due to the preponderance of weekend trips over vacation trips, the weighted average value of swimming occasions for a nonhome-based trip is 1.07;

5. the ratio between the number of swimming occasions consumed and the number of nonhome-based trips generated is approximately one.

Projections of Ontario's population were developed by county and for 1985 to 2035, using a low fertility assumption, 0.27 internal migration factor, and 30,000 people as the net migration figure. These are thought to reflect current circumstances.

Projected use for any year is calculated by dividing Great Lakes projected use by the current population and multiplying the results by the future population, e.g.,

$$\text{Projected use 1990} = \text{1974 use} \times \frac{\text{population 1990}}{\text{population 1974}}$$

Given a projected use for swimming in any year, an allocation of use is divided into the summer months from May to September. The portion of total use occurring in each of these months is calculated using the percent of demand found by the ORS to occur in each month. The distribution of total use by month provided by ORS is for total swimming and assumes that this distribution holds true for swimming in the natural environment as well.

Table G-8 - Origins - Destinations for Swimming
(Total of home and nonhome-based swimming)

DESTINATIONS (administrative districts)	ORIGINS (percent at destination) Administrative Regions			
	Southwestern	Central	Eastern	Algonquin
Chatham	95.975	3.942	0.005	0.027
Aylmer	94.693	3.620	0.011	0.133
Simcoe	49.446	49.821	---	---
Niagara	1.014	98.182	0.390	0.103
Cambridge	1.816	98.017	0.138	---
Maple	0.574	98.172	0.699	0.014
Lindsay	1.877	93.282	4.094	0.732
Napanee	---	13.092	85.867	0.382
Brockville	6.383	9.938	83.678	---
Cornwall	1.359	2.178	96.463	---

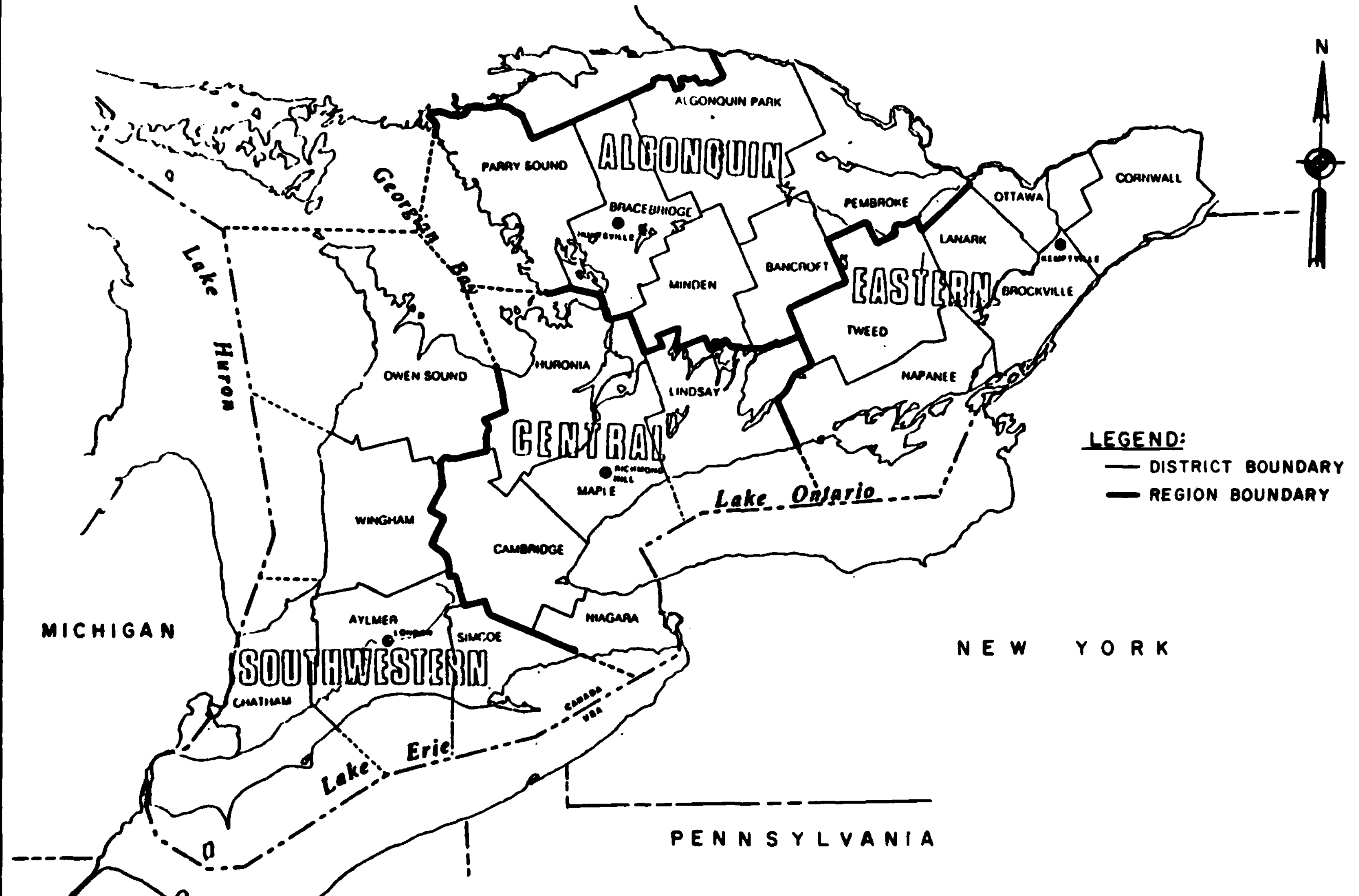
Thus,

Projected use 1990 = (ORS total use) X (percent swimming in natural areas) X (percent swimming in public areas) X (1 / (1 - percent swimming by nonresidents)) X (1990 population / 1974 population) X (percent use per month).

Figure G-3 outlines this procedure diagrammatically.

As an example, consider an administrative district/reach for which demand comes from all four administrative regions (Table G-9).

United States Method: The COMPATRAX model oulined in Annex F provides the basic input into the demand formula for estimating benefits derived from U.S. beaches. The COMPATRAX model utilizes annual per capita recreation rates for discrete populations and multiplies these rates by forecast population. The per capita rates for the four States included in the U.S. forecasts are listed in Table G-10.



ADMINISTRATIVE REGIONS AND DISTRICTS OF THE ONTARIO MINISTRY OF NATURAL RESOURCES

FIGURE G-2

CALCULATING PROJECTED SWIMMING USE

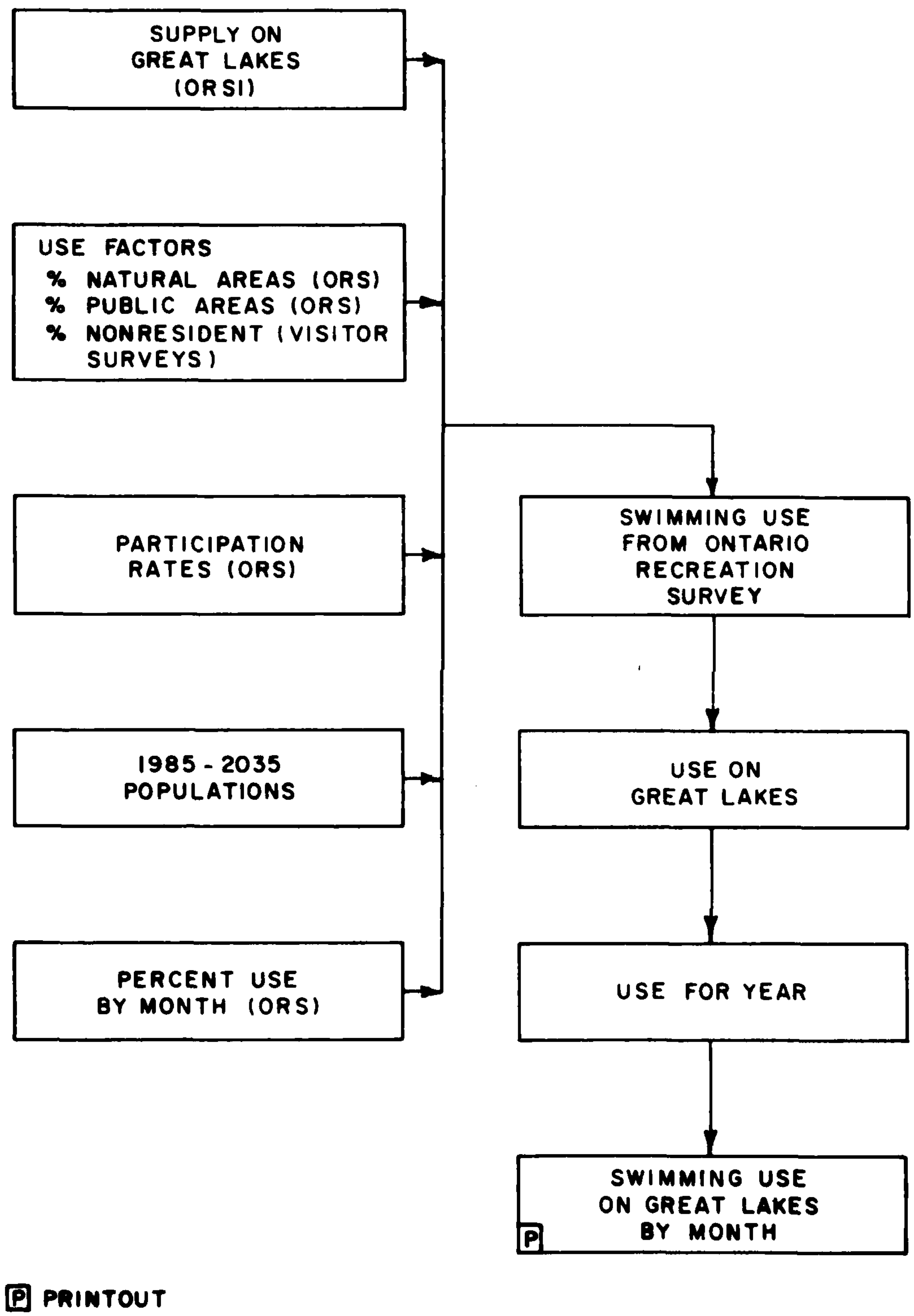


FIGURE G-3

Table G-9 - Example Destination Use for Four Origin Regions

Origin Region	Population of Region 1974 (000's)	Population of Region 1990 (000's)	Use in Destination District (1974) (000's occasions)
1	500	1,000	275
2	2,500	4,500	700
3	400	900	50
4	200	300	50
Total	3,600	6,700	1,075

Projected use from each administrative region =

Region 1: (1,000 / 500) X 275 = 550,000

Region 2: (4,500 / 2,500) X 700 = 1,260,000

Region 3: (900 / 400) X 50 = 113,000

Region 4: (300 / 200) X 50 = 75,000

Sum total by administrative district 1,998,000

	District Value (percent)
Percent of swimming in natural areas	60
Percent of swimming in public areas	75
Percent of swimming each month (July)	44
Percent of swimming on Great Lakes	33
Percent of swimming by nonresidents	25

Projected use (July 1990) = 1,998,000 X .60 X .75 X .44 X .33 X (1/(1 - .25))

= 174,000 occasions (for publicly accessible natural environment swimming within the Great Lakes)

Table G-10 - Occasions for Swimming by State

States	Annual Per Capita Occasions for Swimming in Natural Environments
Michigan	4.71
New York	4.38
Ohio	4.82 (northeast Census Region)
Pennsylvania	4.64

The population forecasts were provided by the Census Bureau's latest "Series E" national population projection, and the Bureau of Economic Analysis' industrial and regional disaggregation thereof, as published in The 1972-E OBERS Projections, November 1974.

The COMPATRAX model is composed of three components:

Projected Use - All projected use areas are located within the model utilizing longitude and latitude coordinates. These spatial locations provide a distance relationship between other projected use areas and the recreation destinations (or supply). For each of the projected use areas, the forecast population for a given year is multiplied by the estimated per capita recreation activity occasions (in this case, annual swimming occasions in a natural environment). The next step in the model is to allocate this projected use (actually, consumption of recreation areas), into the various periods of time that people might take part in the activity. The various leisure activity periods for the model are listed below (Table G-11), along with the percent of projected recreational use that is allocated into each one of the periods:

Table G-11 - Leisure Activity Periods for COMPATRAX

Period	Percent	No. of Occasions/Trip
Few available hours	9	1
All day outings	39	1
Overnight trips	15	2
Vacations	37	3

After the potential demand for a given origin area is segregated into the periods of time during which the activity occurs, the next step is to segregate the amount of activity in each one of these activity periods into the distance band that people might travel to take part in the activity. For example, people participating in few available hours leisure activity period,

are much less likely to travel beyond 50 miles compared to those that are participating in swimming in natural environments on vacations. The distance bands and the percent of swimming activity that takes place within each one of these bands by leisure activity period are provided in Table G-12.

The basic data that have been utilized to separate swimming activity into leisure activity periods and distance zones are provided by a variety of U.S. research studies.

The origin areas for this COMPATRAX analysis includes two to three counties inland from all lakes and waterways in the four States, as well as all of the remaining Standard Metropolitan Statistical Areas (SMSA) in the four States. Non-SMSA population in the remainder of the States was then proportioned into the counties and SMSA's based on their relative size compared to each other.

Table G-12 - Swimming by Distance Zones

One Way Road to Run Between Origin and Destination (Miles)	Percent			
	Vacation	Overnight Trip	All Day Outing	Few Available Hours
0 - 25	0	14	19	65
26 - 50	5	16	19	19
51 - 75	8	22	23	11
76 - 175	20	33	39	5
176 - 275	16	8	0	0
276 - 475	20	6	0	0
>475	31	1	0	0

Supply - As with areas of projected use, supply areas are first located by longitude and latitude coordinates. This provides a relative location to other supply areas, as well as the demand origins. In the Lake Erie model, the supply areas include all of the State Comprehensive Outdoor Recreation Plan (SCORP) supply regions in the four States, as well as the reaches.

The basic supply information in the COMPATRAX analysis was the linear feet of available beach in a supply region. All four States provide an estimate of the linear feet of beach available by SCORP regions. The inventory of beaches on Lakes Erie and Ontario provides an estimate of the linear feet of beach in each of the reaches. No attempt was made to rate the quality of any of the beaches. In other words, each foot of beach in an area was considered of equal quality to a similar measure of beach in every other region.

Allocation - The allocation phase is the final phase of the COMPATRAX analysis. After projected use is estimated for an origin area and apportioned into the leisure activity participation periods and distance zones, the model searches (by origin of projected use) for available supply regions within each one of the activity periods and distance zones. The model then allocates the projected use to the appropriate supply area based on the relative quantity (and quality, if available) of resources within the particular zone.

Example of Allocation Process

For this simplified illustration, one distance band was assumed with all of the swimming occasions occurring during few available hours (9 percent) being allocated among three supply areas. In actual use, the activity by leisure activity period is allocated among seven distance bands. For example, the 4,500 occasions in few available hours would be allocated as follows: 2,925 occasions into 0-25 miles (65 percent), 855 occasions into 26-50 miles (19 percent), and so on. The computer program would then search each distance band for available supply areas and allocate as illustrated above.

Demand Area "n":

Population - 10,000

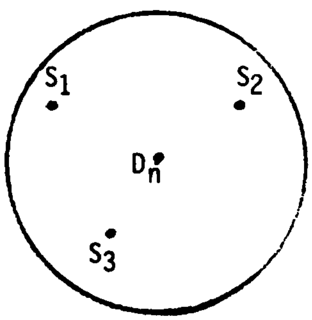
Recreation Rate - 5 occasions/person/year

Total Potential Demand - 50,000 (years)

Allocation:

Few Available Hours - 9 percent or 4,500 Occasions

Three Supply Areas



	Units of Supply	Percent		Occasions Few Available Hours		
Supply 1	100	10	X	4,500	=	450
Supply 2	500	50	X	4,500	=	2,250
Supply 3	400	40	X	4,500	=	1,800
						4,500

The final step in the model is to summarize the projected use that is expended at each of the 17 reaches. The COMPATRAX forecasts of the annual activity days in swimming in natural environments for the 17 United States reaches by decade are shown in Table G-13.

Table G-13 - COMPATRAX Forecasts of the Annual Swimming Occasions in Natural Environments by Year (000's of occasions)

United States Reaches	1985	1995	2005	2015	2025	2035
R008	105	112	120	126	132	138
R007	0	0	0	0	0	0
R006	69	74	80	85	90	95
2005	61	67	73	77	81	85
2004	541	572	608	630	652	674
2003	739	870	1,017	1,085	1,153	1,221
2002	768	906	1,059	1,117	1,175	1,233
2001	419	476	540	568	596	624
R005	0	0	0	0	0	0
R004	1,110	1,174	1,259	1,296	1,333	1,370
3004	5,675	6,097	6,572	6,903	7,234	7,565
3003	6,859	7,423	8,006	8,480	8,954	9,428
3002	4,191	4,649	5,093	5,469	5,845	6,221
3001	1,086	1,214	1,342	1,446	1,550	1,654
R003	1,514	1,674	1,813	1,936	2,059	2,182
R002	3,570	3,950	4,281	4,574	4,867	5,160
R001	0	0	0	0	0	0

COMPATRAX forecasts of annual activity occasions were then converted into the projected use occurring during peak swimming periods by month for each of the reaches utilizing the equation shown below:

$$\text{Projected Use for Recreation Beaches} = \text{Total Annual Activity Days (COMPATRAX Forecasts)} \times \text{Monthly Activity Factor} \times \text{Peak Day Use Factor}$$

A computer program utilized the COMPATRAX forecast of annual activity days for swimming in natural environments for each of the reaches and future years as a basic input. It may be noted that there are no forecasts of swimming in natural environments for some of the reaches such as R007. No public beaches are located in these regions, thus the areas do not attract public beach use.

The second step in the forecast of projected use was to distribute the annual activity days provided by the COMPATRAX model into the five summer months. The Canadian element of the Lake Erie Regulation Study developed a considerable amount of data for the 10 Canadian reaches. Utilizing these data, an average rate of swimming activity by month was developed, and applied to the COMPATRAX annual activity day forecasts for the 17 United States reaches. The monthly factors are shown below:

Months	Month Factors
May	0.100
June	0.173
July	0.397
August	0.269
September	0.062

With the COMPATRAX annual activity days distributed by month for future years, the final step was to parcel out the amount of this monthly use that might occur on peak days. Daily gate counts at a major United States beach were used to calculate this factor. Daily and monthly gate counts were available for the 5-year period 1976-1980. These data were averaged to determine the amount of the monthly activity that occurred on peak days. These average coefficients are:

Month	Peak Day Factors
May	0.50
June	0.42
July	0.44
August	0.37
September	0.53

The coefficients show the amount of monthly use that might occur on peak days during each of the months, i.e., one-half of the May visits can occur on a Saturday, Sunday, or Memorial Day. These factors were multiplied by the previously developed matrix to produce the amount of peak use that occurs by month by reach for each of the future years.

3.2.4 Value of an Opportunity

To make the results of the beaches component comparable with other aspects of the study, a dollar value was determined for beach opportunities created or lost due to the regulation plans. In this case, the value of an opportunity is the sum of the cost of the average distance travelled and the average weighted entrance fee.

The approach to evaluating an opportunity chosen was, in effect, the "cost of getting there." While willingness to pay may give a value that is more reflective of how the people of the study area actually view the opportunity of going to a beach, these data were not easily and uniformly available. Data on the cost of travelling plus entering a beach area, however, were available.

Data regarding origin of day-users by county or municipality were obtained from two surveys carried out by Parks Planning, MNR; the Wheatley Provincial Park 1975 Day-User Survey, Report No. 2, and the 1976 Provincial Park Day-User Survey, Summary Statistical Report. These surveys provided information on five Provincial parks within the study area: Wheatley, North Beach, Presquile, Long Point, and Darlington.

Canadian Method: For the purposes of determining distance travelled, the parks were located on an Official Road Map of Ontario, produced by the Ministry of Transportation and Communications and the Ministry of Industry and Tourism. An Alvin 1112 map wheel was used to measure distance travelled from each origin to each park. Where origins were stated as municipalities, the road closest to the centre of the municipality was used as the starting point. In the case of county origins, the principal population centre was used as the starting point. Where more than one principal population centre was evident, measurements were taken from the road closest to the approximate midpoint between or among them. In counties where there was no principal population centre (incorporated town or larger), measurements were taken from the road closest to the midpoint of the county.

For out-of-province origins, distance was measured from the point of nearest entry. Responses in the "Other Canada," the "U. S.," and "Unspecified" categories were excluded from the distance calculation.

Distance was measured along the shortest route using roads of paved tertiary quality or better.

The distances calculated for each park are listed in Table G-14. Detailed computations of these distances is given in Annex G.

Table G-14 - Travel Distances for Provincial Parks in the Study Area

Park	One-Way Distance (mi)	Round Trip Distance (mi)
Wheatley	38	76
Long Point	70	140
Darlington	44	88
Presquile	91	182
North Beach	73	146

The average round-trip distance travelled is 127 miles.

In determining the value of distance travelled, considerations included such costs as depreciation and insurance. Although these costs are not as immediately evident as those such as the cost of gasoline, they nevertheless are a very real part of the cost of owning and operating a motor vehicle. The values used in this study were provided by the Canadian Automobile Association in an April 1979 publication entitled Car Costs, 1979. The average cost of operating a standard-sized car with an automatic transmission is 19.6 cents/mile. For a subcompact car with a standard transmission, the average cost is 17.8 cents/mile. The average of these two values is 18.7 cents/mile. These costs are based on driving 15,000 miles/year and include fixed costs of insuring, licensing, depreciation, and driving, plus variable costs of gas, oil, tires, and routine maintenance.

Attendance records from provincial parks indicate the number of occupants to be from 2.8 to 6.2. After consultation with Provincial Parks Branch, 3.7 was chosen.

The weighted average entrance fee was provided by ORSI. Table G-15 lists these by MNR administrative district.

Subsequent to the completion of the analysis including the calculation of discounted benefits per regulation plan, adjustments were required both to consider round-trip distance instead of the one-way distance used initially and to alter the average cost per mile from the April 1977 value to the June 1979 price. As both these adjustments affect discounted benefits in a linear fashion, a single factor was applied to the initial results.

The factor was derived by taking the initial value of an opportunity and dividing this into the adjusted value. The factor used was 2.078 as average round-trip distance was used for all administrative districts.

Table G-15 - Weighted Average Entrance Fee by Administrative District

MNR District	Weighted Average Entrance Fee
	$
Chatham	0.72
Aylmer	.53
Simcoe	.83
Niagara	.69
Cambridge	.56
Maple	.73
Lindsay	.57
Napanee	.43
Brockville	.51
Cornwall	.40

Table G-16 presents the values of opportunities by administrative district for both one-way (using April 1977 cost/mile) and round-trip (using April 1979 cost/mile) distances, using the following:

$$\text{Value of an Opportunity} = \frac{(\text{average cost per mile}) \times (\text{average weighted distance travelled})}{(\text{average number of people per vehicle}) + (\text{average weighted entrance fee per person})}$$

Table G-16 - Value of a Beach Opportunity by Administrative District

MNR Administrative District	One-Way (April 1979 Cost Per Mile	Round Trip (April 1979 Cost Per Mile)
	$	$
Chatham	3.72	7.73
Aylmer	3.53	7.36
Simcoe	3.83	7.96
Niagara	3.69	7.67
Cambridge	3.56	7.40
Maple	3.73	7.75
Lindsay	3.57	7.42
Napanee	3.43	7.13
Brockville	3.51	7.29
Cornwall	3.40	7.07
Average	3.60	7.48

Table G-17 is a summary listing of swimming opportunities by selected MNR districts and selected months. The opportunities represent "actual" opportunities for the general public on a daily basis.

Some points to bear in mind when interpreting the tabled figures are:

1. All sites with beaches have been included for each district and not only those which are located directly on the Great Lakes;

2. Factors utilized to calculate the space standard were: 3.5, 7.5, 15, 30, 60, and 100 (midpoints of sunbathing range) multiplied by the beach length and divided by 100 square feet;

3. The value calculated in (2) was then multiplied by the midpoint of the range for day-use. These factors were 0, .13, .38, .63, .88, and 1. The latter product was subsequently multiplied by the appropriate monthly factors for turnover rate, days per month of swimming, and institutional constraint factor;

4. The average fee was calculated by totalling the fees charged on a daily basis and dividing through by the number of sites charging such fees;

5. The four columns dealing with "sites" will give an indication of total sites with beaches, the number offering some day-use swimming, those offering no day-use swimming and day-use sites charging a fee.

6. Present opportunity value has been calculated for each MNR district based on the total opportunities multiplied by the average weighted fee and does not represent true value or the value resulting from the adjusted water levels.

United States Method: Origin areas affecting demand at particular destination areas (a United States reach) are available from the COMPATRAX model. This output provides the potential number of visits that is estimated to be generated by the origin areas. This model, along with average road mile distances from each origin area to each reach was utilized to determine the overall travel cost. Average weighted values by reach were utilized, together with the model's forecast of recreation visits to determine the total potential benefits that might be generated by beaches along the United States shoreline.

The value per visit, that was arrived at using the above, is shown in Table G-18. These values are slightly higher than the average Canadian value of a recreational beach opportunity. Although there are several probable reasons for the difference in values, the major reason is the physical structure of the COMPATRAX model. The COMPATRAX model is essentially a regional model and enables projecting recreation use from a large number of demand areas. In this case, the demand areas include several counties deep along the United States Great Lake shoreline and the Standard Metropolitan Statistical Areas (SMSA) in the four States. As a result, the SMSA's tend to dominate the model in terms of demand generated by origin areas. Essentially, recreation use generated by all SMSA counties, including the counties between the adjacent lake counties and the more distant SMSA's, was distributed from the SMSA location points based on their relative size compared to each other. For example, if an SMSA has 50 percent of the total SMSA population in the State, half of the non-SMSA population is allocated from this physical location. Thus, while the overall estimates of recreation use are accurate estimates of future use, the market summaries that were initially utilized to generate the value of the visit tended to overestimate the value of recreation visitation. An adjustment was made to correct the overestimate. The overall weighted average utilizing the COMPATRAX approach before adjustment was $10.12; and after adjustment was $6.40.

Table G-17 - Swimming Opportunities

MNR District	Actual Opportunities May	Jun	Jul	Aug	Sep	Total Opportunities	Average Weighted Fee	Sites with Fees	Sites with No Day-Use	Sites with Day-Use	Total Sites	Present Opportunities Value
							$					$
Aylmer	19,217	36,618	95,630	101,834	61,584	314,883	.53	12	2	30	32	166,888
Chatham	95,497	276,813	491,683	472,325	379,409	1,715,727	.72	16	15	76	91	1,235,323
Owen Sound	41,577	285,729	703,265	672,303	145,076	1,847,950	.53	14	35	81	116	979,414
Simcoe	7,111	51,747	100,921	108,638	51,293	319,710	.83	16	4	24	28	265,359
Wingham	13,393	75,038	132,097	130,813	50,821	402,162	.39	13	3	47	50	156,843
Cambridge	23,644	86,433	173,391	163,408	85,907	532,783	.56	38	8	59	67	298,358
Huronia	13,760	140,152	294,573	343,499	93,774	885,758	.99	33	166	213	379	876,900
Lindsay	8,387	43,721	131,162	102,788	54,071	340,129	.57	28	181	111	292	193,874
Maple	21,500	155,384	354,257	345,462	142,191	1,018,794	.73	30	37	91	128	743,720
Niagara	70,699	261,966	356,652	463,963	321,934	1,475,214	.69	15	10	47	57	1,017,898
Brockville	7,900	20,425	36,129	35,166	17,053	116,673	.51	14	35	32	67	59,503
Cornwall	13,977	42,720	72,938	70,477	34,353	234,465	.40	12	5	20	25	93,786
Napanee	36,321	151,560	321,953	312,537	134,969	957,340	.43	26	73	69	142	411,656
Parry Sound	1,485	10,892	31,486	31,750	5,776	81,389	.84	7	129	65	194	68,367
Totals	374,468	1,639,198	3,296,137	3,354,963	1,578,211	10,242,977	.64	274	703	965	1,668	6,567,889

Table G-18 - Value Per Visit Utilized to Compute Benefits for the United States Reaches

Reach	COMPATRAX
	$
R008	6.27
R007	--
R006	9.77
2005	7.90
2004	9.09
2003	7.08
2002	5.77
2001	10.61
R005	--
R004	3.26
3004	14.91
3003	14.02
3002	10.48
3001	4.52
R003	2.88
R002	3.29
R001	--

3.2.5 Determining Benefits and Losses

The difference between the supply available due to the plans, and the basis-of-comparison supply, once a value is attached, is the benefit or loss due to regulation. The added qualification is that the supply must be required to meet projected use before it can be considered a benefit.

Canadian Method: For the purposes of this analysis, a model was developed for the Canadian shore to examine the influences of regulation plans on supply and demand. This simulation model was run for the three regulation plans (6L, 15S, and 25N) for the period 1985 to 2035 using each month from May to September as a separate time period in each year.

Basis-of-comparison water levels from 1900 to 1976 were available for simulation purposes. Various 51-year sequences of water levels were derived from these data in order to represent a range of possible real-world conditions for the period 1985-2035. While actual levels and fluctuations in 1985-2035 may be quite different from one of the periods simulated, it can be expected to most likely be within the range of options simulated.

The major input components of the model included supply, projected use, and values which have been described in Sections 3.2.2, 3.2.3, and 3.2.4, respectively. The manipulation of these basic elements of the model to arrive at a benefit or loss due to one of the regulation plans occurred in the following manner:

For each simulation period, two units of swimming supply are calculated:

1. Basis-of-comparison supply or supply with no regulation plan. Basis-of-comparison supply must be calculated for each time period because water levels differ between time periods; and,

2. additional or lost supply due to the regulation plan.

Figure G-4 illustrates how this is done.

The calculation of basis-of-comparison supply starts with the supply of swimming on the Great Lakes as specified by ORSI. ORSI supply is revised in each time period to bring these data to basis-of-comparison conditions. Revisions follow the method described in Section 3.2.2 and are carried out for individual beaches. In this case, the change in water level is defined as water level when supply data were gathered minus basis-of-comparison (BOC) water level. Thus, for each beach:

Supply revisions = (original water level - BOC water level) X (length) X (slope) X (supply factors)

Revisions are done for all beaches and then summed for each administrative district.

CALCULATING ADDITIONAL AND BOC SUPPLY

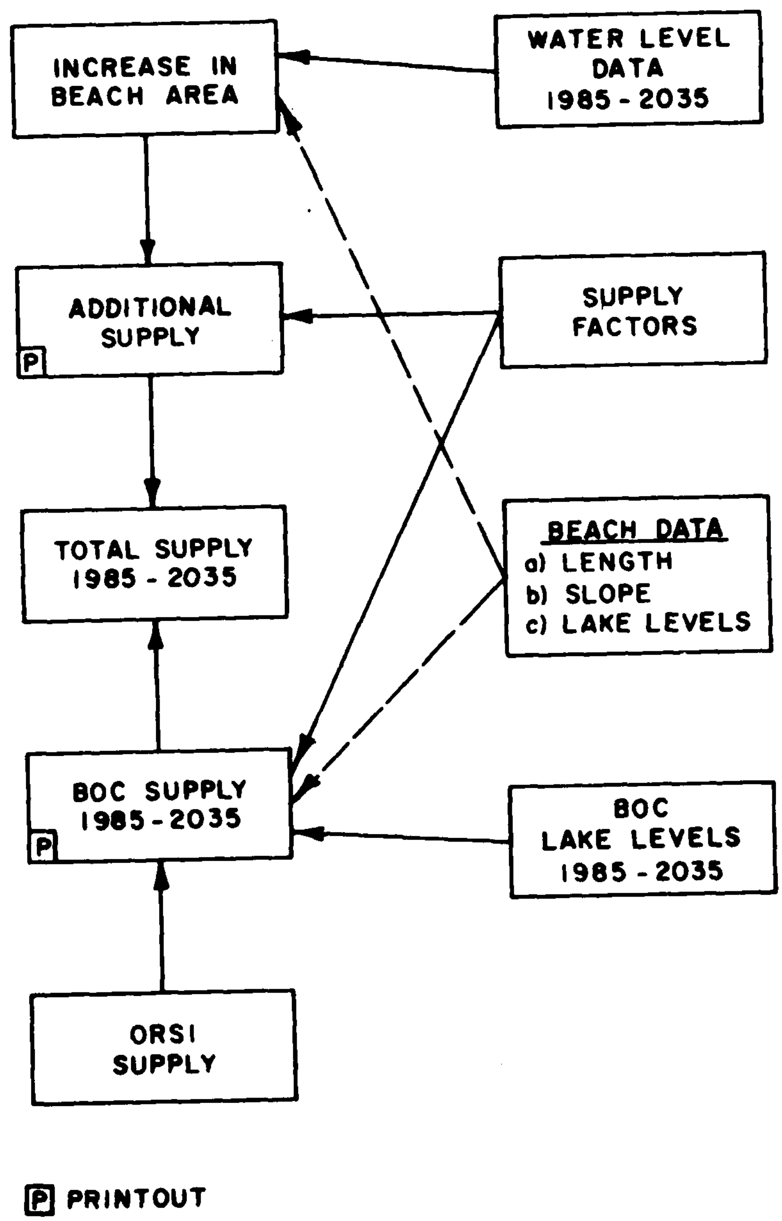


FIGURE G-4

Thus, District BOC supply = (ORSI supply) + beaches (BOC supply revisions)

To continue with the example used in 3.2.2:

BOC supply = (length) X (width) X (space standard) X (turnover rate) X (number of days available in June) X (institutional constraint factor) = 325 x 100 x $\left(\frac{1}{100}\right)$ x 1.2 x 14.1 x .143 = 786 opportunities

Thus, this beach provides 786 opportunities for swimming in June, while

Additional supply = (length) X (width of new beach) X (space standard) X (turnover rate) X (number of days available in June) X (institutional constraint factor) = 325 X (.75 X 5/1.5) X $\left(\frac{1}{100}\right)$ X 1.2 X 14.1 X .143 = 20 opportunities

The lowering of lake level by .75 foot results in 20 more opportunities of swimming in June from this beach. The width of the new beach is calculated by multiplying the change in lake level by the beach's slope. The beach's slope is derived by dividing the wet beach width, in this case, 5, by 1.5 since wet beach width is the width of wet beach to a depth of 1.5 metres of water.

A change in additional supply is caused by the water level being raised or lowered due to a regulation plan and can, therefore, be either positive or negative. Regulation plans lower or raise the water levels. The amount water levels are lowered or raised is specified for each of the plans in a particular format. Annex H specifies the format for these data.

Additional supply is calculated for each beach using the length and slope of a beach combined with corresponding water level data. The number of opportunities of supply that the new beach area would provide can be easily calculated using the supply equation described in 3.2.2. For a given beach: additional supply = (change in water level due to regulation) X (length) X (slope) X (supply factors).

The model sums the additional supply for all beaches in each administrative district and then sums this with BOC supply to give total supply. Opportunities of supply used and benefits are given dollar values and used in the model.

The major purpose of the simulation model is to determine if benefits or losses occur due to the regulation plans. If new supply is created and used, benefits occur, and if new supply is created and not used, no benefits occur. As much of the new supply is used as is demanded. Conversely, supply may be decreased by the regulation plan. Losses occur if supply, that would otherwise be used, is eliminated by the regulation plan.

The trade-off table (Figure G-5) indicates when benefits or losses occur with + and - signs. Benefit/loss is calculated on an administrative district basis. Some administrative districts are on more than one lake in which case benefits occurring in the district are divided among the lakes in proportion to the current supply on the lakes.

Knowing the amount of supply used provides an idea of the magnitude of overall benefits i.e., when one knows supply is used, one can consider the ratio of benefits to supply used. The supply used (Figure G-6) is defined as the lesser of the demand or of the quantity of benefits plus BOC supply. Supply used is equivalent to the demand that is satisfied for each administrative district.

Opportunities of supply used and benefits are given dollar values and discounted as shown in Figure G-6 on a yearly present value basis and summed across years. A discount factor of 8.5 percent and a base year of 1985 are used. Thus, for a given year: Present Worth Factor = $(1/(1+.085))^n$ where n = given year - base year.

United States Method: The methodology used to evaluate U.S. beaches implies that at "0" water level, no losses or benefits are incurred. Losses were measured as the loss of user-days that might occur as a lake rises and beach area is covered by water. Benefits, on the other hand, are the additional user-days accommodated by expanding beach areas as the water level is lowered.

To evaluate the potential benefits or losses associated with recreational beaches, the value of the potential available supply and demand by reach was estimated and compared at various lake levels. For the purpose of this analysis, a common reference lake level was established ("0" fluctuation level) for each water body; all subsequent analyses related to seven different water levels above and below this "0" level (with the range extending from +4 to -6 feet).

Because the recreation inventory took place over a 3-month period, and the lakes and connecting waterways did not maintain a constant water level during this period, all beaches in the study area were adjusted to the common reference level for the reach where they were located. Since the time of day and date were specified on each inventory form, it was possible to determine the exact water level at the nearest gaging station during the time of the inventory. The first step in the lake level analysis, therefore, was to adjust each beach area measurement from the level at the time of inventory to the appropriate reference water level. The reference water levels for each reach are listed in Table G-19.

BENEFIT TRADE-OFF TABLE

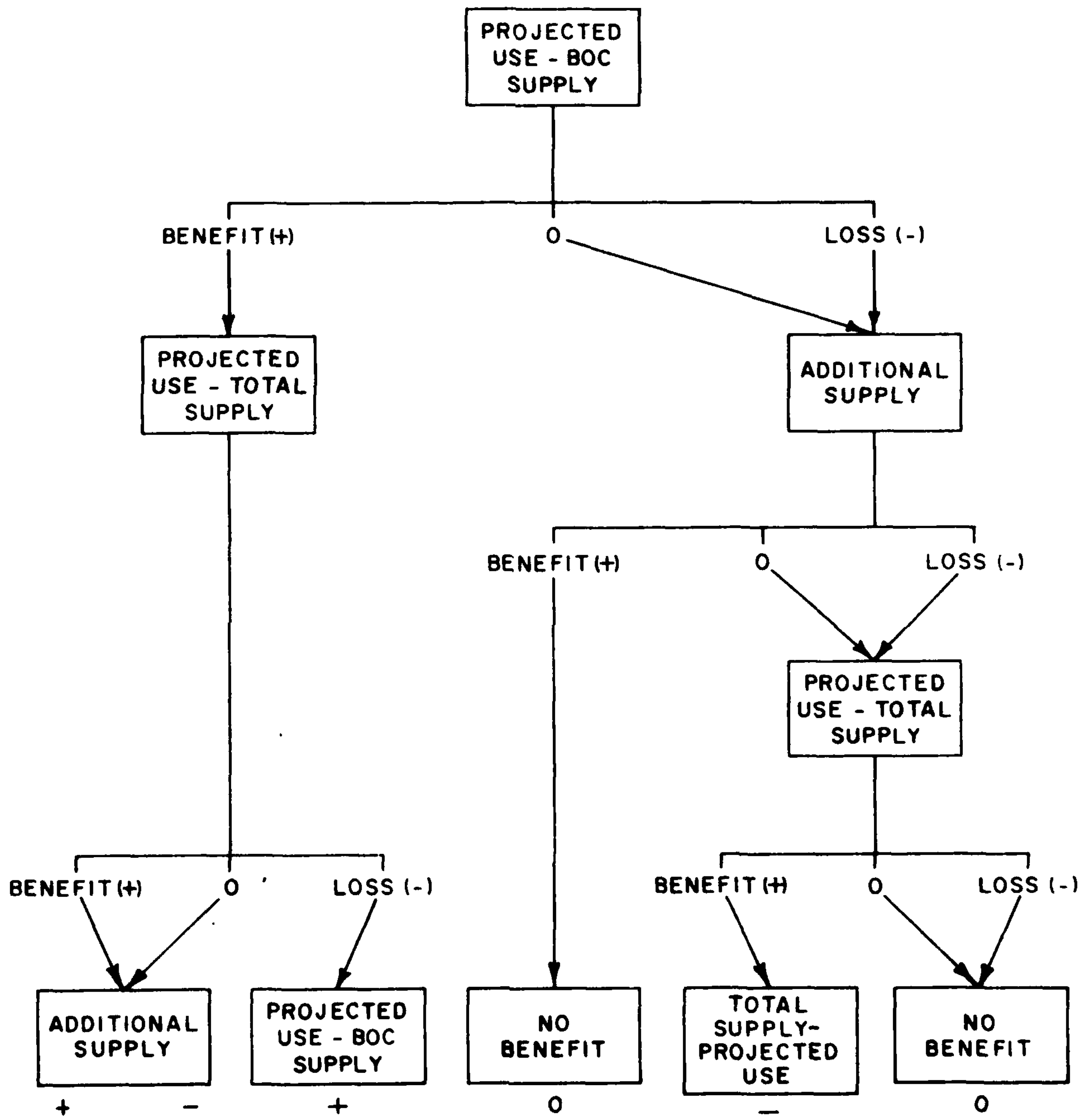


FIGURE G-5

OUTPUT OF BENEFITS AND SUPPLY

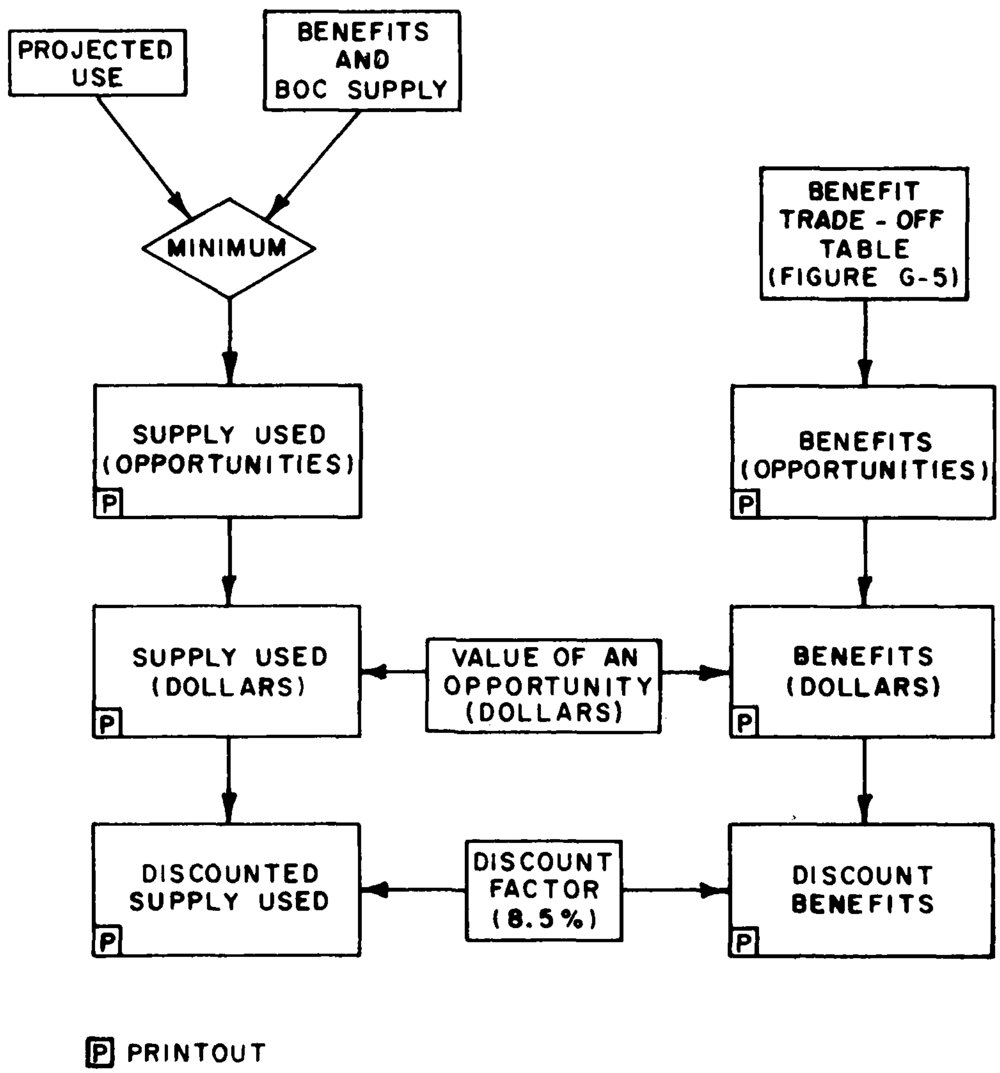


FIGURE G-6

Table G-19 - Reference Water Level and Gaging Stations for United States Reaches

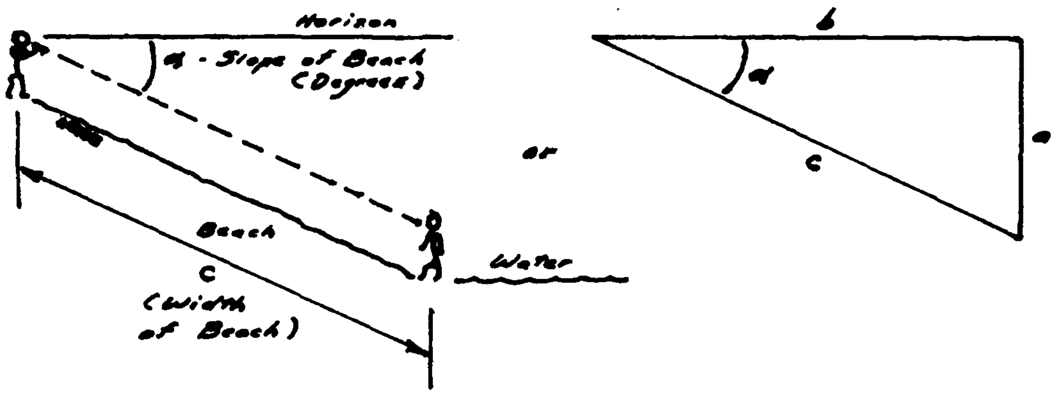
		Reference Level	Gaging Station
St. Lawrence River	R008	241.8	Morrisburg, Ontario
	R007	243.3	Cardinal, Ontario
	R006	244.9	Ogdensburg, NY
Lake Ontario	2005		Cape Vincent, NY
	2004		Oswego, NY/Cape Vincent, NY/ Oswego, NY 1/
	2003		Oswego, NY
	2002	245.5	Rochester, NY
	2001		Olcott, NY
	R005		Olcott, NY
Niagara River	R004	563.9	Tonawanda Island, NY
Lake Erie	3004		Buffalo, NY/Erie, PA 1/
	3003		Cleveland, OH
	3002	571.3	Marblehead, OH/Toledo, OH 1/
	3001		Toledo, OH
Detroit River	R003	573.1	Ft. Wayne, MI
Lake St. Clair	R002	574.1	St. Clair Shores, MI
St. Clair River	R001	575.9	St. Clair, MI

1/ In some instances, two gages were within the same reach. In these instances, the closest gaging station was used.

For example, beach number 35, near Buffalo, NY, (reach R004) was inventoried on 27 June 1979. The water level on that date was 564.6 feet (as recorded at Tonawanda Island, NY, gaging station). In comparing this to the reference water level, this water level on that date was 0.7 foot higher.

Adjusting the beach areas to a single point in time (reference water levels) was done in two steps. The first step was to compute the area of dry beach when the lake/waterway is at the reference level. In the simplest of terms, this is a (length) X (width) measurement for each facility. In order to compute this factor, the length of all public and community beaches in each reach was summed. If measurements were unavailable for a particular beach, the average length of beach for the total reach was applied to the missing facility. Next, the average width of beaches for the total reach was multiplied by the length estimate in the reach to determine the total area in beaches by reach. Before this was done, however, the width measurements were adjusted to the reference water level. This was accomplished by computer

technique through a simple series of calculations using trigonometric functions. The graphic presentation below shows the similarity between the dry beach measurements and a right triangle:



Using average measurements throughout the reach, the following trigonometric functions were calculated:

1. Determine average angle α and width (c) for sample points.

2. Compute a:

   $\sin\alpha = a/c$
   $a = \sin\alpha \times c.$

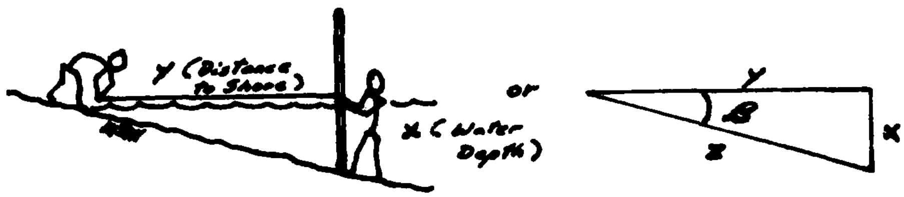
3. Adjust a to reference level: $a' = a +$ (measured level - reference level)

4. Compute the average width of the dry beach (reach, lake, or total population) for the reference level:

   $\sin\alpha = a'/c'$
   $c' = a'/\sin\alpha$ (c', being the computed value of the dry beach width).

The resulting adjusted width of dry beach was then multiplied by the length of the public and community beaches in each reach. This provided an estimate of the total area of dry beach by reach at the reference level ("0" water level fluctuation). This value could then be evaluated in terms of changing water levels.

The graphic presentation below shows the similarity between the wet beach measurements and a right triangle. Again, using trigonometric functions, the width of the wet beach could be calculated when the lake is at the reference water level. These calculations are shown below:



1. Determine average depth (x) and distance from the waterline (y) for sample points.

2. Compute width of wet beach:

   $z = \sqrt{x^2 + y^2}$.

3. Substituting values, compute $\sin\beta$:

   $\sin\beta = x/z$.

4. Finally, compute width of wet beach at reference water level (z').

   $z' = x'/\sin\beta$; where $x' = x +$ (reference level - measured level).

If the lake level is raised above the reference level, then the change between the wet beach width at the reference water level and the new level (the difference) would be the width of beach lost. If the lake level is lowered, then the change between the wet beach width at the reference level and the new water level would be the width of beach gained.

The final step in the analysis of impacts in water level changes was to determine the change in beach width by applying this change in wet beach widths to the dry beach width previously computed. The new beach areas could then be established for all reaches at the selected water levels. The total length of public and community beaches was multiplied by the new beach widths at the various water levels. Annex D presents the type of information available for each reach. (In that annex, the top part of the tables show the average length and width along with the number of beaches in the sample, the standard deviation, and the total length of beaches in the reach. The lower part of the tables show the change in the average width, as well as the total area with changing water levels. The information in these tables was utilized in the subsequent economic impact analysis).

There are two separate phases associated with the development of benefits generated at the various water levels in the U.S. reaches. The beaches have the capability of accommodating a given level of use. This capability is determined by the area of beach, which in turn is affected by the water level. As shown in Section 3.2.2, other influencing factors include the degree of crowding users are willing to endure (the space standard), the number of times a beach area can be utilized more than once during a day, (the turnover rate), and the number of peak days of use in a given period of time (weekend days and holidays per month). Peak days are also affected by both recreation utilization patterns, i.e., the standard workweek and leisure time availability, and weather. The supply portion of the analysis is basically a determination of the supply capability (how much use beaches are capable of providing). The second phase of the analysis was to determine the amount of use for beaches. Projected use is affected by the growth in swimming activity, the month that the activity usually occurs, as well as the time of the week that participation occurs.

Both the supply capability, and the levels of projected use (by reach, month, and water level) were multiplied by the previously developed COMPATRAX values to determine the stage value relationship (or water level vs. value) of beaches (supply capability) and potential benefits of recreation beaches (projected use for beaches).

The stage-value (supply) that might be provided by the recreation beaches for each reach is shown in Annex I. The results are based on COMPATRAX values. The fluctuation in potential value of beaches by month results from the fluctuation in the number of peak days the beach might be used during the highest use days of the season. The fluctuation of potential values within a given month varies with changes in water levels. It may be noted that the higher the water level, the lower the value because less beach is available for use. The opposite is true with lowering the water levels, hence a higher value.

Annex J shows the potential benefits that would be generated for beaches in the study area in terms of COMPATRAX values. In that annex, values corresponding to projected use are presented by reach in terms of month and future year. The previously described COMPATRAX model was utilized to forecast recreation participation in each one of the reaches. Using the previously described equation, annual recreation occasions of swimming were converted to monthly swimming occasions occurring on peak days.

A comparison of regulation plans and basis-of-comparison was done as follows. Water levels were derived for Lakes Erie, Ontario, and St. Clair, as well as at index points of reaches on the interconnecting channels. Water levels were generated for the period 1900-1976 under basis-of-comparison, 6L, 15S, and 25N regulation plans. These levels or stages were then ranked from lowest to highest, and stage-duration curves were developed for each water body. Basically, this measures the probability that a water level will be equalled or exceeded. Stage-value relationships (by reach and decade) were coupled with each duration curve, to calculate the expected annual value for each plan (i.e., BOC, 6L, etc.) by reach and month.

The expected annual value is the frequency weighted sum for the full range of values from expected water levels and can be viewed as what might be expected to occur in any present or future year. Expected annual values are computed for each input data year (1985-2035) by first computing a value-frequency relationship from stage, frequency (duration), and value data for each month, reach, and regulation plan. Each value is then weighted according to its percent chance of occurrence.

Within the period of analysis, expected annual value is computed for each year. This is done by first computing expected annual values for the base year (1985), and each decade year (every 10 years from the beginning of the operation). Between any pair of input data years, the stage-value data are calculated by linear interpolation. Expected annual values are then computed for each year of the period of analysis.

Each year's expected annual value, which is assumed to occur at the end of the year, is discounted back to the beginning of the base year, then amortized for the period of analysis. The discounting equation used is

$$\frac{p}{f} = \frac{1}{(1+i)^n}$$

where:

p = Present amount (at beginning of base year) of some future amount.

f = Future amount.

n = Number of years the future amount is from present.

i = Discount rate (8.5%).

The present amount of all future amounts over the period of analysis is amortized using the equation

$$\frac{A}{P} = \frac{i\ (1+i)^n}{(1+i)^n - 1} \quad \text{(Capital Recovery Factor)}$$

where:

A = Equivalent annual amount.

P = Present amount (at beginning of base year).

n = Period of analysis (50 years).

i = Discount rate (8.5%).

This procedure yields equivalent average annual values for each plan by month (May through September) and reach. The difference in equivalent average annual values (i.e., 6L-BOC, 15S-BOC, etc.) produced the benefits/losses to each plan.

Comparison of Methods: The variability of data available in the United States and Canada has led to some subtle differences in methods employed to obtain the benefits/losses on recreational beaches under the regulation plan alternatives. Annex K contains detailed results of Canadian stage-value data for the Canadian Lake Erie reaches (Niagara, Simcoe, Aylmer, and Chatham) combined with stage-duration data used in the U.S. method. Average annual benefits for the 25N Plan (Category 2), using the U.S. method for Canadian reaches on Lake Erie are $1,525,000. This compares to 3 percent less benefits obtained using the Canadian "simulation" method ($1,566,000). This small difference is well within the expected accuracy of either method and, therefore, both methods are considered reasonable for the purposes of this study.

3.3 Benefits and Losses

Tables G-20, G-21, and G-22 summarize the results of the analysis of the regulation plans under Categories 1 and 2 against the basis-of-comparison and Category 3 against the basis-of-comparison and adjusted basis-of-comparison, respectively. Impacts of the regulation plans are presented in net present worth and equivalent average annual values expressed in July 1979 dollars. All plans show a negative impact or loss for reaches on Lake Ontario. This is expected as the passage of additional water from Lake Erie raises slightly the level in Lake Ontario causing a reduction in beach area.

The greatest benefits would occur on Lake Erie. Plan 25N would result in significant overall benefits as compared to the 15S and 6L Plans. The plan with the least impact, 6L, is of such magnitude that the inaccuracy of components used in calculating the results may well be of such a nature as to preclude a conclusion one way or the other.

Table G-20 - Economic Impacts on Recreational Beaches, Benefits or Losses Under Category 1

		Impact of Regulation Plan ($000)1/					
		Plan 6L		Plan 15S		Plan 25N	
Waterway	Country	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value
Lake St. Clair (Including St. Clair River)	Canada	112	10	344	30	803	69
	US	41	4	134	12	404	35
Lake Erie (Including Detroit River and Upper Niagara River)	Canada	2,463	213	6,666	576	18,110	1,566
	US	6,975	603	20,875	1,805	51,604	4,462
Lake Ontario (Including Lower Niagara River)	Canada	NE	NE	NE	NE	NE	NE
	US	46	4	528	46	-121	-10
St. Lawrence River	Canada	NE	NE	NE	NE	NE	NE
	US	-14	-1	-25	-2	0	0
Entire Study Area	Canada	2,575	223	7,010	606	18,913	1,635
	US	7,048	610	21,512	1,861	51,887	4,487
	Total	9,623	833	28,522	2,467	70,800	6,122

NE - Not Evaluated

1/ July 1979 price level.

Table G-21 - Economic Impacts on Recreational Beaches, Benefits or Losses Under Category 2

Waterway	Country	Impact of Regulation Plan ($000) 1/ Plan 6L Net Present Value	Plan 6L Average Annual Value	Plan 15S Net Present Value	Plan 15S Average Annual Value	Plan 25N Net Present Value	Plan 25N Average Annual Value
Lake St. Clair (Including St. Clair River)	Canada	112	10	344	30	803	69
	US	41	4	134	12	404	35
Lake Erie (Including Detroit River and Upper Niagara River)	Canada	2,463	213	6,666	576	18,110	1,566
	US	6,975	603	20,875	1,805	51,604	4,462
Lake Ontario (Including Lower Niagara River)	Canada	-283	-24	-790	-68	-3,106	-269
	US	-312	-27	-601	-52	-1,226	-106
St. Lawrence River	Canada	NE	NE	NE	NE	NE	NE
	US	-81	-7	-58	-5	-116	-10
Entire Study Area	Canada	2,292	199	6,220	538	15,807	1,366
	US	6,623	573	20,350	1,760	50,666	4,381
	Total	8,915	772	26,570	2,298	66,473	5,747

NE - Not Evaluated

1/ July 1979 price level.

Table G-22 - Economic Impacts on Recreational Beaches, Benefits or Losses Under Category 3

Waterway	Country	Impact of Regulation Plan ($000)1/ Plan 6L Net Present Value	Plan 6L Average Annual Value	Plan 15S Net Present Value	Plan 15S Average Annual Value	Plan 25N Net Present Value	Plan 25N Average Annual Value
Lake St. Clair (Including St. Clair River)	Canada	112	10	344	30	803	69
	US	41	4	134	12	404	35
Lake Erie (Including Detroit River and Upper Niagara River)	Canada	2,463	213	6,666	576	18,110	1,566
	US	6,975	603	20,875	1,805	51,604	4,462
Against Basis-of-Comparison							
Lake Ontario (Including Lower Niagara River)	Canada	NE	NE	NE	NE	NE	NE
	US	-506	-44	-163	-14	-1,592	-138
St. Lawrence River	Canada	NE	NE	NE	NE	NE	NE
	US	-34	-3	-46	-4	-75	-6
Entire Study Area	Canada	2,575	223	7,010	606	18,913	1,635
	US	6,476	560	20,800	1,799	50,341	4,353
	Total	9,051	783	27,810	2,405	69,254	5,988
Against Adjusted Basis-of-Comparison							
Lake Ontario (Including Lower Niagara River)	Canada	NE	NE	NE	NE	NE	NE
	US	-1,134	-98	-787	-68	-2,221	-192
St. Lawrence River	Canada	NE	NE	NE	NE	NE	NE
	US	-34	-3	-46	-4	-75	-6
Entire Study Area	Canada	2,575	223	7,010	606	18,913	1,635
	US	5,848	506	20,176	1,745	49,712	4,299
	Total	8,423	729	27,186	2,351	68,625	5,934

NE - Not Evaluated

1/ July 1979 price level.

Section 4
RECREATIONAL BOATING

4.1 Introduction

4.1.1 The Study Area

The study area for this evaluation extends along the United States shoreline of Lakes Erie and Ontario and the interconnecting waters between Massena, NY, and Port Huron, MI. The interconnecting waters include the St. Lawrence River, Niagara River, Detroit River, Lake St. Clair, and St. Clair River. The study area was divided into the 17 reaches used by the U.S. Coastal Zone Subcommittee. The selection of the reach areas was based on similar geomorphic characteristics. The study area and reach limits are illustrated in Figure G-7.

4.1.2 Overall Concept

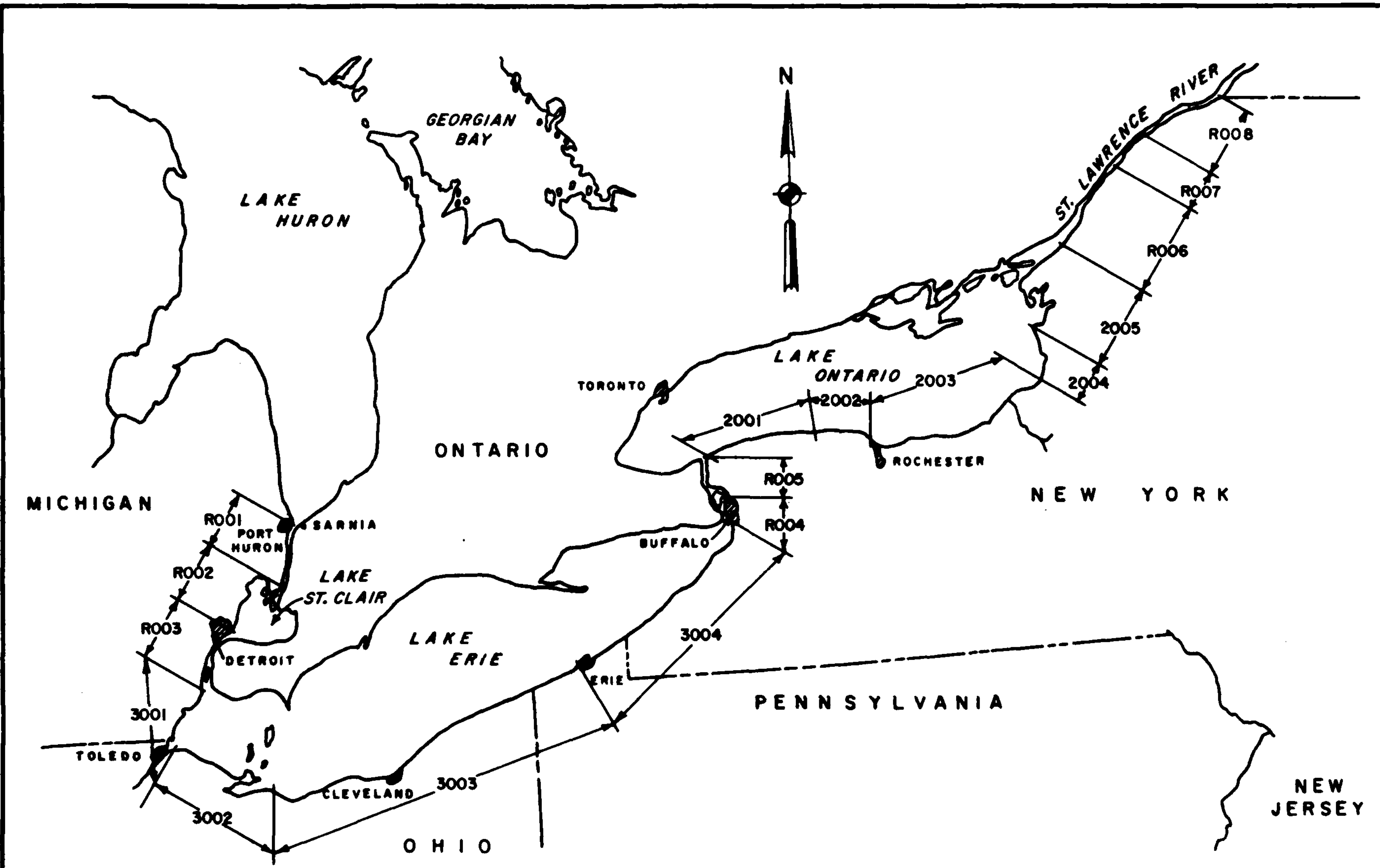
Major changes in water levels affect recreational boating activity. The type of impacts measured in this study are effects on recreational boating resulting from owners being prevented safe ingress/egress from the boat slips or moorings due to insufficient depths. Though it is recognized that "damages" to boating activities may result from water levels too high for boat owners to safely use their crafts (e.g., inundated docks), this analysis only considers the effects of low water level "damages". Also, property damage resulting from high water are not included in this evaluation. These storm damages were considered by the Coastal Zone Subcommittee (see Appendix C, Coastal Zone). Furthermore, this analysis considers only the effects of water level fluctuations on recreational boating for activities originating at commercial facilities (e.g., marinas). Boats berthed at private residences, summer cottages, etc. are not considered in this analysis.

Impacts to recreational boating which result from limited regulation of Lake Erie are calculated as the difference in "damages" resulting from any particular lake regulation plan and those "damages," if any, which would occur with basis-of-comparison and adjusted basis-of-comparison conditions.

4.1.3 The Inventory

The inventory was conducted from mid-June through mid-September of 1979. The inventory included interviewing facility operators/managers and collecting boating facility measurements.

A total of 662 boating facilities were identified in the study area. The bulk of these (over 90 percent) are in private ownership, with municipal and State Governments owning most of the remaining facilities. Almost all of the boating facilities (93 percent) are in private management. Some of the boating facilities on public lands are operated by private concessionaires under lease with the Government.



U.S. STUDY AREA AND REACH LIMITS USED IN THE RECREATIONAL BOATING EVALUATION

FIGURE G-7

The following procedure was utilized to collect the information regarding boating facility measurements. After the interview had been completed, the crews evaluated the marina area which includes moorings and berths/slips. A random sample of 10 percent of the moorings and slips were selected for measurements. In the case of the moorings, the interviewers often asked the facility operator to take them by boat to determine boat class/length and license numbers, as well as depth and bottom material of the moorings.

The interviewers used the following procedure in collecting the mooring/slip information. For example, suppose a facility contained 100 slips. The crews obtained slip depth, boat class/length, and license number at 10 random slips. At each selected slip the water depth was taken. The day and time of each depth reading was also recorded in order to relate actual water level readings at the closest gage station. The actual measured depths at the various boat slips were determined through the use of gage stations adjusted to a common reference level. The gage stations used throughout the study area were the same as were used for the beach evaluation of U. S. reaches (see Table G-19).

While the crews were at the slip, boat length/class and license number of the boat occupying the slip were also recorded. If the slip did not contain a boat, the boat length/class and license number of a boat in the nearest slip was noted.

A questionnaire was used to obtain information concerning the capacity and utilization of boating facilities. A total of over 52,000 wet berths/slips are located throughout the study area; there are over 700 moorings (see Table G-23). Over 40,000 boats can be stored on the property of these boating facilities. Almost half (319) of the facilities have some type of launch ramp and most of the facilities (466) have some type of hoist to accommodate boaters' needs. The operators in the study area indicate that the occupancy for the wet berth/slips is 87.6 percent. This means that almost 46,000 of the available slips are utilized during the boating season. A total of 81.1 percent of the moorings are occupied (over 600). Over half of the marina owners (54.2 percent) indicate they set aside slips for transient use; this is nearly seven slips and/or moorings per facility available for transient use. A total of 43 percent of the operators indicate they have an agreement with regular renters to use their slips or moorings for transients when they are not in use by the regular renter.

Table G-23 - United States Boating Facility Capacity

	Lake St. Clair (includes St. Clair River)	Lake Erie (includes Detroit & Upper Niagara Rivers)	Lake Ontario (includes Lower Niagara River)	St. Lawrence River	Total Study Area
Wet Berths/Slips	11,215	33,522	6,141	1,304	52,182
Moorings	0	225	517	0	742
Dry Storage	11,400	23,066	4,997	894	40,357
Launch Ramps	35	186	80	18	319
Launch Capacity (Boats/Hr.)	329	1,415	642	148	2,534
Ramp Parking Spaces	1,671	8,236	5,148	836	15,891
Hoist	133	241	72	20	466

In Table G-24, a breakdown of the results of the inventory is presented both in terms of slip size and number of craft moored. It also shows the mean length of the slip classes. In general, there appear to be larger numbers of small boats in the fleet compared to available slips less than 26 feet in size. There are 2,742 boats less than 26 feet long and only 1,630 slips available for this size class, a shortage of 1,112 slips. It was also noted that in the larger classes, there were fewer boats than available slips. Obviously, owners have the flexibility of utilizing these large slips for small boats.

Table G-24 - Utilization of Marina Slips by Size Class

	Inventoried Marina Slips	Number of Craft in Slips	Additional Craft to be Accommodated	Mean Length (Feet)
Less than 16 Ft.	265	280	-15	11.8
16 to 26 Ft.	1,365	2,462	-1,097	21.4
26 to 40 Ft.	2,127	1,647	480	31.3
40 to 64 Ft.	751	127	624	44.2
64 Ft. and Up	11	3	8	72.7

Based on the 10 percent random sample, the fleet mix was established for the study area. Since some facility owners could not be contacted to obtain permission to conduct the inventory, the information for all facilities was not available. Utilizing the survey results, the total number of slips was estimated in the study area. The fleet mixes were adjusted for both the wet berths/slips and moorings using the previously mentioned occupancy rate. The fleet mix of wet berths/slips for the study area is shown in Table G-25. A total of nearly 55 percent of the boats are in the 16 to 26 foot class, with over 35 percent in the 26 to 30 foot class. Over two-fifths (44.4 percent) of the boats are of either the outboard, inboard/outdrive, or inboard class. One-fifth (19.1 percent) of the boats are either sailboat or auxiliary sailboats (with engine). Over one-third (34.9 percent) are some type of boat with overnight cruising facilities. The remainder are either houseboats, pontoon boats, or some form of other craft.

Table G-25 - Fleet-Mix, Wet Berths/Slips

	Less Than 16 Ft.	16 to 26 Ft.	26 to 40 Ft.	40 to 64 Ft.	64 and Over	Total
Outboard	2,821	3,607	31	21	0	6,480
Inboard/Outdrive	440	11,565	933	0	0	12,938
Inboard	73	3,051	661	0	0	3,785
Sailboat	94	493	524	42	0	1,153
Aux. Sailboat	115	4,666	3,911	157	0	8,849
Cruiser	21	5,064	11,775	1,038	21	17,919
House/Pontoon	0	94	619	147	0	860
Other	136	42	63	10	10	261
Total	3,700	28,582	18,517	1,415	31	52,245

The fleet mix of the moorings is shown in Table G-26. A total of 650 boats are moored in the study area with the bulk of these (51.4 percent) being 26 feet or larger. Nearly all (92.3 percent) are either sailboats or auxiliary sailboats.

Utilization and depths at berths/slips and moorings statistics by reach are shown in Annex L, Descriptive Recreational Boating Statistics. The detailed field inventory data are on file at the Corps of Engineers, Buffalo District Office.

Table G-26 - Fleet-Mix, Moorings

	Less Than 16 Ft.	16 to 26 Ft.	26 to 40 Ft.	40 to 64 Ft.	64 and Over	Total
Outboard	10	0	0	0	0	10
In/Outboard	0	10	0	0	0	10
Inboard	0	10	0	0	0	10
Sailboat	0	38	29	0	0	67
Aux. Sailboat	10	228	295	0	0	533
Cruiser	0	10	10	0	0	20
House/Pontoon	0	0	0	0	0	0
Other	0	0	0	0	0	0
Total	20	296	334	0	0	650

4.2 Methodology

The method employed to calculate benefits and losses of the three regulation plans on recreational boating is explained in detail in three separate sections: Stage-Damage Relationship (4.2.1); Stage-Duration Relationship (4.2.2); and, Average Annual Damage Computation (4.2.3). The stage-damage relationship is the measurement of the effects of various water levels on boating use. If the water level as measured at a gage station on a particular day indicates that the average depth is 4 feet at the berths in a particular harbor, then it is assumed that any boat which drafts less than 4 feet can enter and leave its berth while a boat with a draft of 4 feet or greater would be unable to safely leave or enter its berth. The small boat formula[1/] relates these impacts to dollar values. This evaluation technique is described below:

Small Boat Formula -- The "small boat formula" is described as follows: "Boat owners are assumed to receive nonmonetary returns in the form of boating enjoyment that would be equivalent to the rate of return on investments of comparable size in the 'for hire' boating sector and the absence of impediments to boating." The investment upon which the calculations are made

1/ Derived from U.S. Army, Corps of Engineers, "Survey Investigation and Reports--Benefit Evaluating and Cost Sharing for Small-Boat Harbor Projects," EM 1120-2-113, June 11, 1959.

is based on the depreciated value of the fleet, which is taken to be equal to 50 percent of the purchased price where:

- Average age of a boat in the fleet is n/2 (n = life of the asset); and

- Straight line depreciation is used.

These calculations are carried out for all classes of boats that are based at the marina facilities.

Stage-duration is a measure that relates the probability of each water level occurring or being exceeded. Stage-duration relationships were developed for each of the regulation plans and for the basis-of-comparison for each water body in the study area. Each stage-duration relationship is derived from water level data from May through September for the period 1900-1976. It is assumed May through September, inclusive, represents the recreational boating season throughout the study area. Though recreational boating occurs as early as April and as late as October, many studies indicate that boating in these months (April and October) accounts for a negligible portion of total boating activity.

The third component, the average annual damage computation, represents the integration of the stage-damage and stage-duration relationships. This computation measures the damage that would be expected to occur in any one year. Average annual damage is computed using associated stage-duration relationships for each of the regulation plans and for the basis-of-comparison. The difference in average annual damages under each regulation plan and the basis-of-comparison produces the benefits or losses associated with each regulation plan.

4.2.1 Stage-Damage Relationship

Stage-damage curves were developed using data gathered from the inventory along with recreational boating data compiled by the U.S. Army Corps of Engineers, Buffalo District. Table G-27 lists each data input used in the analysis and its source.

The stage-damage computations are presented by reach in Annex M. Table G-28 illustrates for example the computation for reach R003. The inventory provided the average slip/berth depths and average mooring depths by reach along with fleet mix distribution by reach. The number of vessels in each class and length category are listed in descending order by required draft. The average depreciated values are multiplied by the number of boats within each class and the product is multiplied by the corresponding average rate of return for the class of boat. 1/ This product (shown in the

1/ The tables containing average depreciated boat values by class and length and rate of return schedule by class are presented in Annex L, Descriptive Statistics.

Table G-27 - Stage-Damage Input Data

	Data	Source
1	Average slip/berth and mooring depths by reach.	Inventory conducted by Midwest Research Institute (MRI), 1979.
2	Class/length fleet mix distributions at slips/berths and moorings by reach.	Inventory conducted by MRI, 1979.
3	Average depreciated boat value matrix by class and length.	USAED Buffalo, 1979 1/
4	Average draft matrix by class and length.	USAED Buffalo 2/
5	"Rate of Return" matrix by class.	Small Boat Formula 3/
6	Growth factor matrix.	MRI Gravity Demand Model 4/

1/ Average boat values were derived by taking an average of half the F.O.B. prices for 1977 boats by class and length listed in the 1978 Blue Book Trade In Guide, ABOS Marine Publications Division, and updated by price level.

2/ Average draft matrix was developed for previous Buffalo District small boat harbor reports from Empirical data and interviews.

3/ Rate of return matrix was calculated using average rates of return by class used in previous Buffalo District reports under guidance from EM 1120-2-113, June 11, 1959.

4/ Growth factor matrix developed by Midwest Research Institute. See Annex O.

Table G-28 Stage-Damage Computation, Reach R003

WATERWAY Detroit River
REACH R003
AVERAGE DEPTH 6.2
ZERO REFERENCE WATER LEVEL 573.1

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.2		
6.0	Aux Sail	40-64	56	58,040	.075	243.8	243.8	5.2		
6.0	Cruiser	>64	11	250,000	.075	206.3	450.1	5.2		
6.0	Other	>64	0	150,000	.10	0	450.1	5.2		
5.5	Cruiser	40-64	189	69,500	.075	985.1	1,435.2	5.2	1,435.2	572.1
5.0	Sail	26-40	11	7,890	.10	8.7	1,443.9	4.2		
5.0	Aux Sail	26-40	289	20,090	.075	435.4	1,879.3	4.2		
5.0	House/Pontoon	40-64	33	25,500	.10	84.2	1,963.5	4.2		
5.0	Other	40-64	0	34,430	.10	0	1,963.5	4.2	1,963.5	571.1
4.0	Sail	16-26	56	3,890	.10	21.7	1,985.2	3.2		
4.0	Aux Sail	16-26	545	9,500	.075	388.4	2,373.6	3.2		
4.0	Cruiser	26-40	1,268	24,340	.075	2,314.7	4,688.3	3.2		
4.0	House/Pontoon	26-40	56	15,500	.10	86.8	4,775.1	3.2		
4.0	Other	26-40	0	13,870	.10	0	4,775.1	3.2		
3.5	Cruiser	16-26	311	7,770	.075	181.2	4,956.3	3.2	4,956.3	570.1
3.0	Cruiser	<16	0	5,200	.075	0	4,956.3	2.2		
3.0	House/Pontoon	16-26	0	3,500	.10	0	4,956.3	2.2		
3.0	Other	16-26	0	6,050	.10	0	4,956.3	2.2		
3.0	In/Out	26-40	78	10,530	.125	102.7	5,059.0	2.2		
3.0	Inboard	26-40	33	13,530	.10	44.6	5,103.6	2.2		
2.5	Sail	<16	0	880	.10	0	5,103.6	2.2		
2.5	Aux Sail	<16	0	1,280	.075	0	5,103.6	2.2		
2.5	In/Out	16-26	1,168	6,180	.125	902.3	6,005.9	2.2		
2.5	Inboard	16-26	89	8,300	.10	73.9	6,079.8	2.2		
2.5	Outboard	40-64	0	6,200	.125	0	6,079.8	2.2	6,079.8	569.1
2.0	Inboard	<16	0	5,200	.10	0	6,079.8	1.2		
2.0	Other	<16	0	2,920	.10	0	6,079.8	1.2		
2.0	Outboard	26-40	0	5,200	.125	0	6,079.8	1.2		
1.5	Outboard	<16	111	1,160	.125	16.1	6,095.9	1.2		
1.5	In/Out	<16	0	3,800	.125	0	6,095.9	1.2		
1.5	Outboard	16-26	22	3,180	.125	8.7	6,104.6	1.2	6,104.6	568.1

1/ Cumulative totals may not add due to rounding.

column entitled "Total Return") reflects the estimated total value of the boating experience for an entire boating season by class/length and reach. The example for reach R003 lists a total of 67 boats (56 aux. sail: 40'-64' and 11 cruisers: > 64') which require a draft of six feet. The total value returned to the owners of these vessels for one season is calculated as $450,100 ($243,800 + $206,300). In the same reach there are 189 cruisers: 40'-64' which require a draft of 5.5 feet. The total return to this class/length is calculated to be $985,100 for the season.

The average depth of berths/slips in reach R003 is 6.2 feet at the reference water level of 573.1 IGLD. If the water level remained at 573.1 on reach R003 for the entire boating season, boat owners would enjoy the total return value of their boating experience for the season. It then follows that there are no "damages" at 573.1. "Damages" for an analysis such as this are not physical damages. They are the value of foregone recreational experiences due to insufficient depths for vessel use. If, however, the water level remained at 572.1 in reach R003 (one foot lower than the reference water level) throughout the boating season, the average available depth at berths/slips would only be 5.2 feet. Recreational craft berthed at this reach with required drafts of 5.5 and 6.0 feet would not be able to enter or leave their berths and damages totaling $1,435,200 would result ($450,100 + $985,100 per draft class respectively). A complete stage-damage relationship is developed by recording the total damage that would occur at various levels below the reference water level. Table G-29 provides a summary of stage-damage relationships for each reach.

4.2.2 Stage-Duration Relationship

The stage-damage curve developed in the previous section is a static relationship. The example used in the previous section illustrates the total damages that would occur if the water level remained constant for an entire recreational boating season. Of course, this is an unrealistic situation in that water levels are fluctuating continuously. This section relates this phenomenon and addresses water levels as a dynamic variable. Stage-duration curves, displaying the likelihood of equaling or exceeding a given level for each reach, were developed for each of the regulation plans and the basis-of-comparison.

Monthly mean water levels were obtained for the recreational boating season (May through September) for the period 1900-1976 under basis-of-comparison, and 6L, 15S and 25N regulation plans. Levels were ranked from highest to lowest and assigned a probability based on the percent of time each level was equalled or exceeded during the period of record. Stage-duration curves derived for Lake Erie which compare the basis-of-comparison vs. the regulation plans are illustrated in Figures G-8, G-9, and G-10. A complete listing of stage-duration data used in the evaluation are presented in Annex N, entitled Stage-Duration Data.

4.2.3 Average Annual Damage Computation

Average annual damage is the measure of damages to recreational boating that on average can be expected to occur in any year. It is calculated by

Table G-29 - Existing Stage-Damage Summary by Reach

Waterway	Reach[1/]	Reference Water Level (IGLD)	Damages, 1980 ($000) at Water Levels Below Reference Level						
			0	-1	-2	-3	-4	-5	-6
St. Clair River	R001	575.9	135.9	233.4	1,670.7	2,560.6	2,593.7	2,593.7	2,593.7
Lake St. Clair	R002	574.1	226.4	2,711.1	8,254.2	9,048.3	10,893.7	11,021.0	11,021.0
Detroit River	R003	573.1	0	1,435.2	1,963.5	4,956.3	6,079.8	6,104.6	6,104.6
Lake Erie	3001	571.3	693.2	1,938.6	2,100.5	2,911.5	3,107.1	3,107.1	3,107.1
Lake Erie	3002	571.3	237.1	2,922.9	8,594.9	10,378.9	14,116.9	14,701.1	14,701.1
Lake Erie	3003	571.3	0	862.2	1,830.6	7,186.7	8,529.4	8,771.2	8,771.2
Lake Erie	3004	571.3	0	0	79.9	492.1	908.7	2,186.2	2,532.7
Niagara River (Upper)	R004	563.9	0	82.6	1,077.2	1,350.0	1,782.7	1,926.9	1,926.9
Niagara River (Lower)	R005	245.5	0	0	0	122.3	151.4	164.6	171.3
Lake Ontario	2001	245.5	0	47.9	555.3	867.0	873.5	906.7	938.2
Lake Ontario	2002	245.5	125.1	321.9	570.8	622.5	622.5	622.5	622.5
Lake Ontario	2003	245.5	0	105.2	861.6	1,881.9	1,915.2	2,260.3	2,375.2
Lake Ontario	2004	245.5	0	0	0	4.7	10.8	15.2	15.2
Lake Ontario	2005	245.5	0	249.9	1,076.2	1,775.7	2,018.0	2,090.3	2,138.8
St. Lawrence River	R006	244.9	312.8	384.7	884.3	1,120.0	1,229.3	1,229.3	1,229.3

1/ Damages to recreational boating in reaches R007 and R008 in the St. Lawrence River are negligible or nonexistent.

STAGE DURATION DATA FOR PLAN 6L
LAKE ERIE REACHES 3001 - 3004

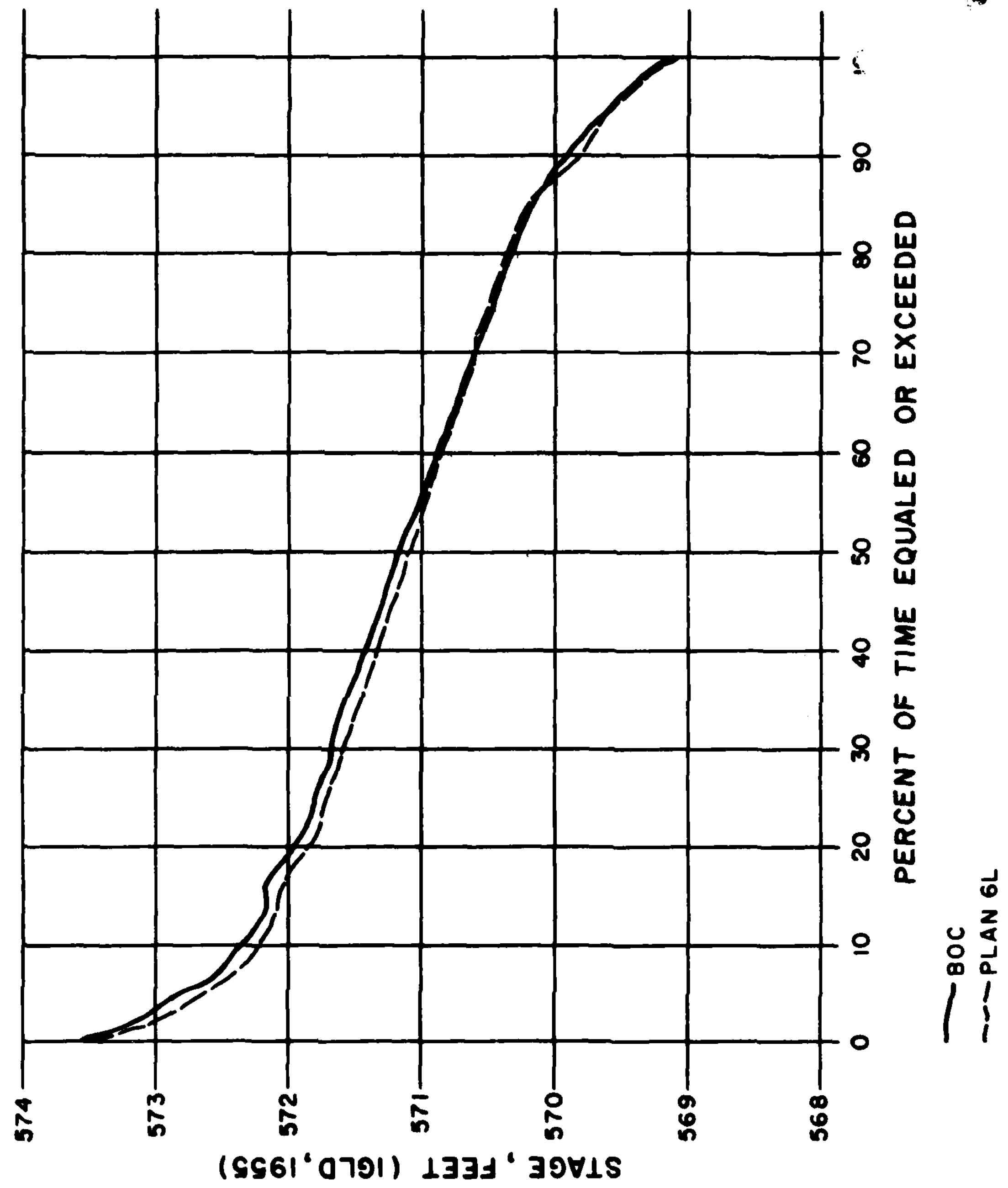


FIGURE G-8

STAGE DURATION DATA FOR PLAN 15S
LAKE ERIE REACHES 3001 - 3004

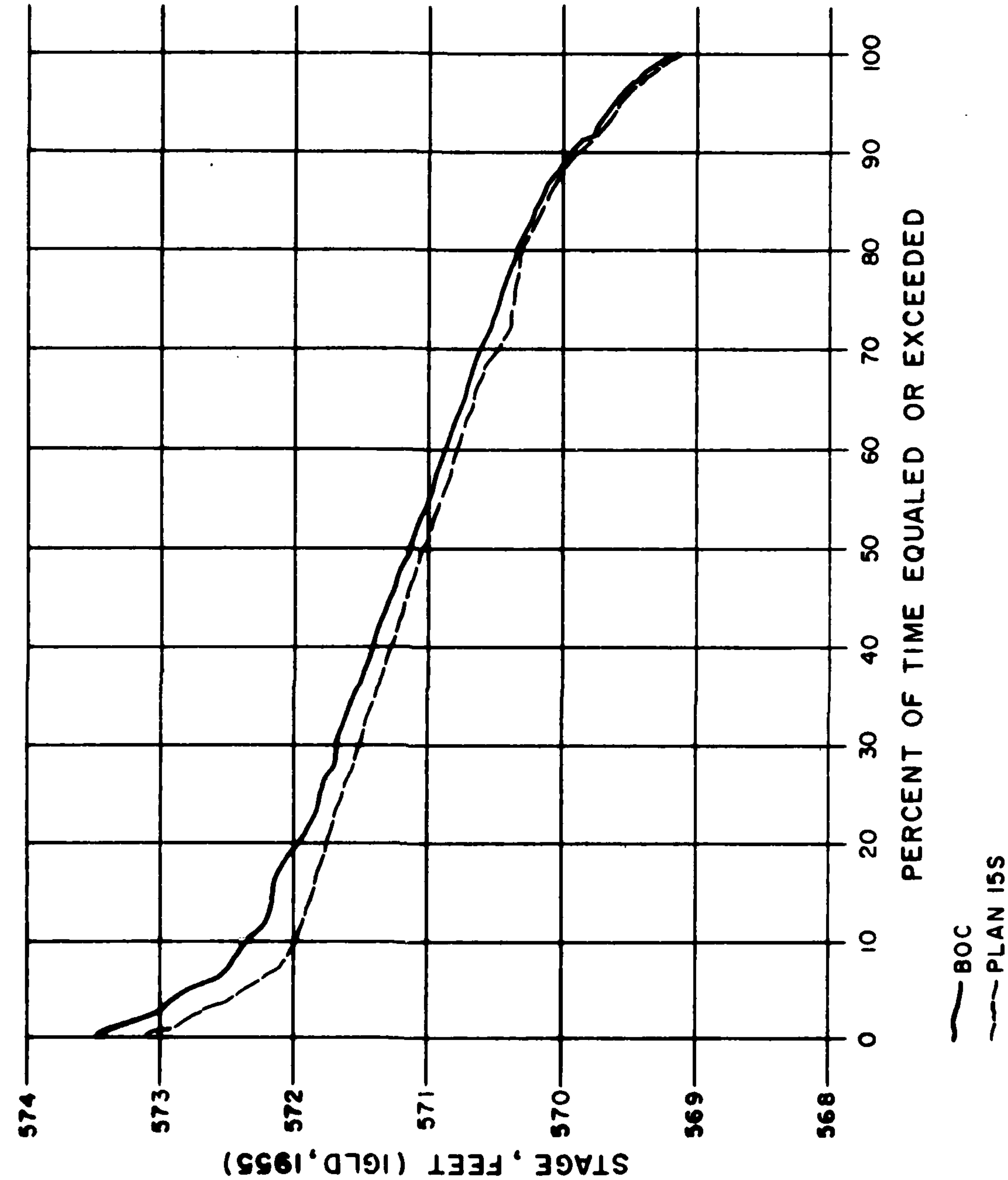
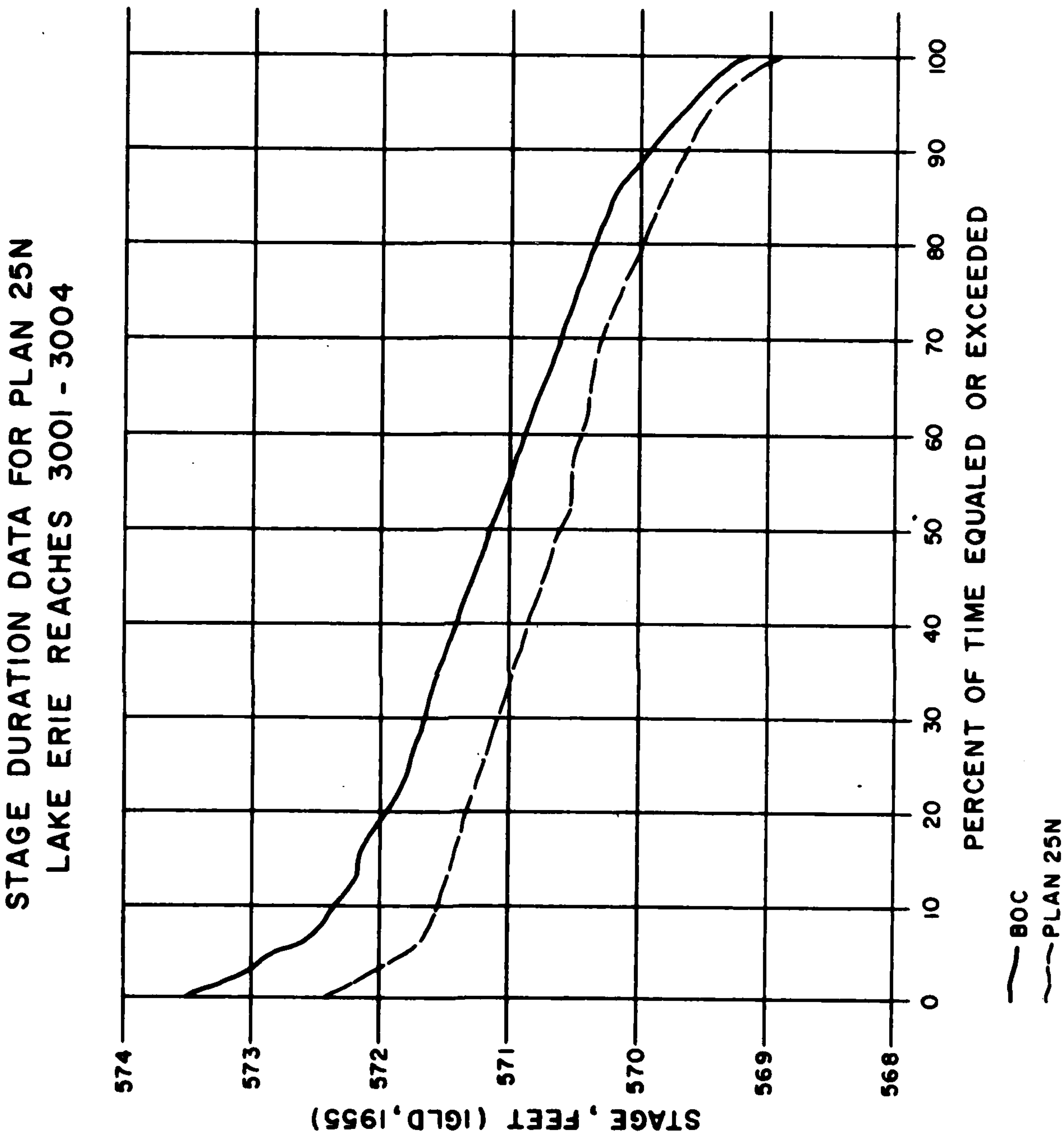


FIGURE G-9



STAGE DURATION DATA FOR PLAN 25N
LAKE ERIE REACHES 3001 - 3004
STAGE, FEET (IGLD, 1955)
574
573
572
571
570
569
568
0
10
20
30
40
50
60
70
80
90
100
PERCENT OF TIME EQUALED OR EXCEEDED
BOC
PLAN 25N

FIGURE G-10

combining the stage-damage relationship by reach with the stage-duration relationship by regulation plan and reach. This is the damage corresponding to each water level weighted by the percent chance of each water level occurring. (Thus, the damage associated with a rarely occurring water level is weighted less.) The sum of the weighted damages represents the expected annual damage to recreational boating. This is accomplished utilizing the generalized computer program, Expected Annual Flood Computation, 761-X6-L7580, June 1977, developed by the Hydrologic Engineering Center (HEC), Davis, CA. Existing average annual damages by plan and reach are presented in Tables G-30, G-31, and G-32.

The stage-damage relationship presented in Section 4.2.1 represents damages to recreational boating based on existing facilities utilization (1980). The demand for berth/slips and moorings at existing commercial facilities within the study area is projected to increase in the future. It follows that damages to recreational boating would increase in future years. Future utilization is determined using a gravity demand analysis. The gravity model is calibrated around the present supply of commercial marina slips for each reach. The inputs include population forecasts, growth in boat registration, distance from market areas to the marina facilities in the reaches, market penetration rates, and moorage capacity in the reaches. The increase in damages is projected by reach and decade for the 50-year project evaluation period. Damages are first projected to 1985 (project year 0). Factors are then developed to calculate the equivalent average annual damages by reach and plan. These factors, along with their calculations, are shown in Table G-33. Equivalent average annual damages by reach and plan are presented in Tables G-34 through G-36. This equivalent value represents a uniform distribution (the same each year) of annual values and is computed by discounting and amortizing each year's expected annual damage value over the period of analysis (1985-2035). The discounting and amortization takes into account the time value associated with damage values in future years. The discount rate used in these calculations is 8-1/2 percent. A more thorough explanation of the gravity demand analysis is contained in Annex O.

4.3 Benefits and Losses

Benefits or losses to recreational boating are calculated as the difference in equivalent average annual damages under basis-of-comparison and adjusted basis-of-comparison conditions and those under each of the regulation plans. Equivalent average annual benefits and losses by plan and reach are listed in Tables G-37, G-38, and G-39. All three regulation plans, 6L, 15S, and 25N, result in a net loss for the entire study area. Regulation plan 25N would produce the greatest loss: $2,981,000 equivalent average annual losses under Category 2.

Table G-30 - Existing Average Annual Damages 1/ by Plan and Reach ($000)
Category 1 2/

Reach	Damages (1980) BOC	6L	15S	25N
St. Lawrence 3/				
Ogdensburg				
R006	302.59	307.53	313.42	302.29
Lake Ontario				
2005	89.34	71.51	97.35	101.68
2004	0	0	0	0
2003	43.99	35.93	48.36	55.26
2002	169.63	149.53	173.59	167.87
2001	22.74	18.82	25.13	30.28
Sub Total	325.70	275.79	344.43	355.09
Lower Niagara				
R005	0	0	0	0
Upper Niagara				
R004	12.23	11.80	13.76	12.54
Lake Erie				
3004	7.48	8.04	8.98	15.91
3003	361.24	419.34	448.34	671.48
3002	1,515.12	1,714.87	1,829.32	2,669.72
3001	897.62	1,007.45	1,068.55	1,375.61
Sub Total	2,781.46	3,149.70	3,355.19	4,732.72
Detroit River				
R003	437.36	440.21	484.70	669.64
Lake St. Clair				
R002	1,421.49	1,501.82	1,636.91	1,944.25
St. Clair River				
R001	138.99	144.00	156.39	182.52
Grand Total	5,419.82	5,830.85	6,304.80	8,199.05

1/ To convert to present worth, multiply by factor of 11.5656.
2/ Lake Ontario regulated as described under the BOC with deviations.
3/ There are no damages associated with boating on St. Lawrence River reaches R007 (Cardinal) and R008 (Morrisburg).

Table G-31 - Existing Average Annual Damages[1] by Plan and Reach ($000) Category 2[2]

Reach	Damages (1980) BOC	6L	15S	25N
St. Lawrence[3]				
Ogdensburg				
R006	301.23	298.25	288.00	283.77
Lake Ontario				
2005	88.92	72.56	73.95	68.20
2004	0	0	0	0
2003	43.77	34.88	33.62	32.24
2002	168.72	155.10	160.59	150.26
2001	22.61	17.74	16.42	16.21
Sub Total	324.02	280.28	284.58	266.91
Lower Niagara				
R005	0	0	0	0
Upper Niagara				
R004	12.23	11.80	13.76	12.54
Lake Erie				
3004	7.48	8.04	8.98	15.91
3003	361.24	419.34	448.34	671.48
3002	1,515.12	1,714.87	1,829.32	2,669.72
3001	897.62	1,007.45	1,068.55	1,375.61
Sub Total	2,781.46	3,149.70	3,355.19	4,732.72
Detroit River				
R003	437.36	440.21	484.70	669.64
Lake St. Clair				
R002	1,421.49	1,501.82	1,636.91	1,944.25
St. Clair River				
R001	138.99	144.00	156.39	182.52
Grand Total	5,416.78	5,826.06	6,219.53	8,092.35

1/ To convert annual damages to present worth, multiply by factor of 11.5656.
2/ Lake Ontario regulated in strict accordance with a modified version of Plan 1958-D.
3/ There are no damages associated with boating on St. Lawrence River reaches R007 (Cardinal) and R008 (Morrisburg).

Table G-32 - Existing Average Annual Damages[1] by Plan and Reach ($000) Category 3[2]

Reach	Damages (1980) BOC	6L	15S	25N
St. Lawrence[3]				
Ogdensburg				
R006	307.15	309.74	300.17	290.00
Lake Ontario				
2005	74.03	74.86	84.75	70.17
2004	0	0	0	0
2003	35.54	34.68	40.56	31.76
2002	159.46	160.17	166.93	154.03
2001	18.06	17.18	20.56	15.46
Sub Total	287.09	286.89	312.80	271.42
Lower Niagara				
R005	0	0	0	0
Upper Niagara				
R004	12.23	11.80	13.76	12.54
Lake Erie				
3004	7.48	8.04	8.98	15.91
3003	361.24	419.34	448.34	671.48
3002	1,515.12	1,714.87	1,829.32	2,669.72
3001	897.62	1,007.45	1,068.55	1,375.61
Sub Total	2,781.46	3,149.70	3,355.19	4,732.72
Detroit River				
R003	437.36	440.21	484.70	669.64
Lake St. Clair				
R002	1,421.49	1,501.82	1,636.91	1,944.25
St. Clair River				
R001	138.99	144.00	156.39	182.52
Grand Total	5,385.77	5,844.16	6,259.92	8,103.09

1/ To convert annual damages to present worth, multiply by factor of 11.5656.
2/ Same as Category 2 except that channel modifications were made to the St. Lawrence River as well.
3/ There are no damages associated with boating on St. Lawrence River reaches R007 (Cardinal) and R008 (Morrisburg).

Table G-33 - Equivalent Value Factor 1/ Computations by Reach (8-1/2 Percent)

Reach	Percent Increase (1) Year 1980 to Year 1985	(2) Year 0 to Year 10 2/	(3) Year 10 to Year 20	(4) Year 20 to Year 30	(5) Year 30 to Year 40	(6) Year 40 to Year 50	(7) Weighted A.A.E. Factor 3/
R008	.11	.05	.06	.05	.05	.05	1.0625
R007	7.0	.09	.04	.08	.04	.03	1.0878
R006	.12	.06	.06	.06	.05	.05	1.0708
2005	.26	.06	.06	.06	.05	.05	1.0708
2004	.27	.04	.05	.07	.04	.04	1.0544
2003	.18	.08	.07	.06	.06	.05	1.0884
2002	.23	.07	.07	.07	.06	.06	1.0827
2001	.13	.07	.07	.07	.06	.06	1.0827
R005	.13	.06	.06	.06	.06	.05	1.0713
R004	.08	.06	.05	.06	.05	.05	1.0678
3004	.08	.06	.06	.06	.05	.05	1.0708
3003	0	0	.02	.06	.05	.05	1.0163
3002	0	0	.04	.06	.05	.05	1.0223
3001	.18	.07	.06	.06	.06	.05	1.0783
R003	.08	.06	.06	.06	.05	.05	1.0708
R002	.11	.06	.06	.06	.06	.05	1.0713
R001	.55	.06	.06	.06	.05	.05	1.0708

1/ Average annual equivalent factor (A.A.E.F.) assumes straight line growth.

2/ Project Year 0 is 1985.

3/ Weighted A.A.E. Factor (7) = 1.0000 +(2) A + (3) B + (4) C + (5) D + (6) E

where, A = A.A.E.F., 10 years growth, 50 year project life = .7069;

B = (A.A.E.F., 10 years growth, 40 year project life = .7004) X (Present worth of 1 per period factor for 40 periods = 11.3145) X (Present worth of 1 for 10 periods = .4423) X (Annuity Factor, 50 periods = .08646) = .3030;

C = (A.A.E.F., 10 years growth, 30 year project life = .6846) X (Present worth of 1 per period factor for 30 periods = 10.7468) X (Present worth of 1 for 20 periods = .1956) X (Annuity Factor, 50 periods = .08646) = .1244;

D = (A.A.E.F., 10 years growth, 20 year project life = .6418) X (Present worth of 1 per period factor for 20 periods = 9.4633) X (Present worth of 1 for 30 periods = .0865) X (Annuity Factor, 50 periods = .08646) = .0454; and

E = (A.A.E.F., 10 years growth, 10 year project life = .4834) X (Present worth of 1 per period factor for 10 periods = 6.5613) X (Present worth of 1 for 40 periods = .0383) X (Annuity Factor, 50 periods = .08646) = .0105.

Table G-34 - Equivalent Average Annual Damages 1/ by Plan and Reach for Category 1 2/ ($000; 8-1/2 Percent)

	Damages BOC	Damages 6L	Damages 15S	Damages 25N
St. Lawrence 3/				
Ogdensburg				
R006	362.89	368.82	375.88	362.53
Lake Ontario				
2005	120.54	96.48	131.34	137.19
2004	0	0	0	0
2003	56.50	46.15	62.11	70.97
2002	225.90	199.13	231.17	223.56
2001	27.82	23.02	30.74	37.04
Subtotal	430.76	364.78	455.36	468.76
Niagara River				
R005	0	0	0	0
Upper Niagara				
R004	14.10	13.61	15.87	14.46
Lake Erie				
3004	8.65	9.30	10.39	18.40
3003	367.13	426.18	455.65	682.43
3002	1,548.91	1,753.11	1,870.11	2,729.25
3001	1,142.12	1,281.87	1,359.62	1,750.32
Subtotal	3,066.81	3,470.46	3,695.77	5,180.40
Detroit River				
R003	505.79	509.09	560.54	774.42
Lake St. Clair				
R002	1,690.36	1,785.88	1,946.52	2,311.99
St. Clair River				
R001	230.68	239.01	259.56	302.93
Grand Total	6,301.39	6,751.65	7,309.50	9,415.49

1/ To convert annual damages to present worth, multiply by factor 11.5656.

2/ Cat 1, Lake Ontario regulated as described under BOC, with deviations.

3/ There are no damages associated with boating on St. Lawrence River reaches R007 (Cardinal) and R008 (Morrisburg).

Table G-35 - Equivalent Average Annual Damages[1/] by Plan and Reach for Category 2[2/] ($000; 8-1/2 Percent)

	Damages BOC	Damages 6L	Damages 15S	Damages 25N
St. Lawrence[3/]				
Ogdensburg				
R006	361.26	357.69	345.40	340.33
Lake Ontario				
2005	119.97	97.90	99.78	92.02
2004	0	0	0	0
2003	56.21	44.80	43.18	41.41
2002	224.69	206.55	213.86	200.10
2001	27.66	21.70	20.09	19.83
Subtotal	428.53	370.95	376.91	353.36
Niagara River				
R005	0	0	0	0
Upper Niagara				
R004	14.10	13.61	15.87	14.46
Lake Erie				
3004	8.65	9.30	10.39	18.40
3003	367.13	426.18	455.65	682.43
3002	1,548.91	1,753.11	1,870.11	2,729.25
3001	1,142.12	1,281.87	1,359.62	1,750.32
Subtotal	3,066.81	3,470.46	3,695.77	5,180.40
Detroit River				
R003	505.79	509.09	560.54	774.42
Lake St. Clair				
R002	1,690.36	1,785.88	1,946.52	2,311.99
St. Clair River				
R001	230.68	239.01	259.56	302.93
Grand Total	6,297.53	6,746.69	7,200.57	9,277.89

1/ To convert annual damages to present worth, multiply by factor 11.5656.

2/ Cat 2: Lake Ontario regulated in strict accordance with a modified version of Plan 1958-D.

3/ There are no damages associated with boating on St. Lawrence River reaches R007 (Cardinal) and R008 (Morrisburg).

Table G-36 - Equivalent Average Annual Damages[1/] by Plan and Reach for Category 3[2/] ($000; 8-1/2 Percent)

	Damages BOC	Damages 6L	Damages 15S	Damages 25N
St. Lawrence[3/]				
Ogdensburg				
R006	368.36	371.47	359.99	347.79
Lake Ontario				
2005	99.88	101.00	114.34	94.67
2004	0	0	0	0
2003	45.65	44.54	52.09	40.79
2002	212.36	213.30	222.31	205.13
2001	22.10	21.02	25.16	18.91
Subtotal	379.99	379.86	413.90	359.50
Niagara River				
R005	0	0	0	0
Upper Niagara				
R004	14.10	13.61	15.87	14.46
Lake Erie				
3004	8.65	9.30	10.39	18.40
3003	367.13	426.18	455.65	682.43
3002	1,548.91	1,753.11	1,870.11	2,729.25
3001	1,142.12	1,281.87	1,359.62	1,750.32
Subtotal	3,066.81	3,470.46	3,695.77	5,180.40
Detroit River				
R003	505.79	509.09	560.54	774.42
Lake St. Clair				
R002	1,690.36	1,785.88	1,946.52	2,311.99
St. Clair River				
R001	230.68	239.01	259.56	302.93
Grand Total	6,256.09	6,769.38	7,252.15	9,291.49

1/ To convert annual damages to present worth, multiply by factor 11.5656.

2/ Category 3: Same as Category 2 except that channel modifications were made to the St. Lawrence River as well.

3/ There are no damages associated with boating on St. Lawrence River reaches R007 (Cardinal) and R008 (Morrisburg).

Table G-37 - Economic Impacts on United States Recreational Boating[1/]
Benefits Or Losses Under Category 1

Waterway	Impact of Regulation Plan ($000) [2/]					
	Plan 6L		Plan 15S		Plan 25N	
	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value
Lake St. Clair (Including St. Clair River)	-1,203	-104	-3,296	-285	-8,026	-694
Lake Erie (Including Detroit River and Upper Niagara River)	-4,696	-406	-7,922	-685	-27,561	-2,383
Lake Ontario (Including Lower Niagara River)	763	66	-289	-25	-439	-38
St. Lawrence River	-69	-6	-150	-13	4	0
Entire Study Area	-5,205	-450	-11,657	-1,008	-36,022	-3,115

1/ Impacts of Lake Erie regulation on recreational boating are not available for the Canadian portion of the study area.

2/ July 1979 price level.

Table G-38 - Economic Impacts on United States Recreational Boating1/ Benefits Or Losses Under Category 2

Waterway	Impact of Regulation Plan ($000) 2/					
	Plan 6L		Plan 15S		Plan 25N	
	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value
Lake St. Clair (Including St. Clair River)	-1,203	-104	-3,296	-285	-8,026	-694
Lake Erie (Including Detroit River and Upper Niagara River)	-4,696	-406	-7,922	-685	-27,561	-2,383
Lake Ontario (Including Lower Niagara River)	671	58	601	52	867	75
St. Lawrence River	46	4	185	16	243	21
Entire Study Area	-5,182	-448	-10,432	-902	-34,477	-2,981

1/ Impacts of Lake Erie regulation on recreational boating are not available for the Canadian portion of the study area.

2/ July 1979 price level.

Table G-39 - Economic Impacts on United States Recreational Boating[1]
Benefits or Losses Under Category 3

Waterway	Impact of Regulation Plan ($000)[2]					
	Plan 6L		Plan 15S		Plan 25N	
	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value	Net Present Value	Average Annual Value
Lake St. Clair (Including St. Clair River)	-1,203	-104	-3,296	-285	-8,026	-694
Lake Erie (Including Detroit River and Upper Niagara River)	-4,696	-406	-7,922	-685	-27,561	-2,383
<u>Against the Basis-of-Comparison</u>						
Lake Ontario (Including Lower Niagara River)	1	0	-393	-34	231	20
St. Lawrence River	-35	-3	93	8	243	21
Entire Study Area	-5,933	-513	-11,518	-996	-35,113	-3,036
<u>Against the Adjusted Basis-of-Comparison</u>						
Lake Ontario (Including Lower Niagara River)	1	0	-393	-34	231	20
St. Lawrence River	-35	-3	93	8	243	21
Entire Study Area	-5,933	-513	-11,518	-996	-35,113	-3,036

1/ Impacts of Lake Erie regulation on recreational boating are not available for the Canadian portion of the study area.
2/ July 1979 price level.

4.4 Sensitivity

Sensitivity tests were performed to measure the effect of altering various components used in the analysis. The primary emphasis was focused on the stage-damage relationship. It is this relationship that may be construed to be in question, in terms of the validity of the assumptions used in its composition and of the results that follow.

It should be noted that many of the input variables which were used to develop the stage-damage relationship are average values. Average values used included: available depth by reach, depreciated boat values, draft of vessel by class, rate of return of boat owner's investment by vessel class, etc. These average values should be considered only as a proxy in determining the magnitude of impacts of the regulation plans and the relative differences in the base cases and the plans.

Changing these average values for sensitivity would shed light as to their relative weight in the overall results. However, considering the complexity of the analysis and the massive size of the study area, it would be impractical to reanalyze the results by changing each of these values. One of the average values, available depth by reach, was tested for sensitivity. It was deemed that benefits and losses are most sensitive to this input variable.

The sensitivity test consisted of using average available depth measurements by harbor/bay for Reach 3004. First, stage-damage relationships were developed on a harbor/bay basis. Fleet mix distributions by harbor/bay were provided from the inventory. Harbors comprising Reach 3004 include Buffalo, Dunkirk, and Presque Isle. The remaining fleet mix in Reach 3004, not based at one of the above harbors, is classified as other.

Table G-40 - Sensitivity Results, Reach 3004
Average Harbor Depth Versus Average
Depth by Reach ($000)

	Average Annual Damages and Benefits1/						
Reach	Basis of Comparison	Plan 6L	Damage Reduced	Plan 15S	Damage Reduced	Plan 25N	Damage Reduced
3004	7.53	8.09	-.56	9.04	-1.51	16.00	-8.47
3004A2/	22.13	25.57	-3.44	27.35	-5.22	41.20	-19.07

1/ Damages and benefits (losses) are for 1980 conditions (no growth).
2/ Reach 3004A uses the adjusted stage-damage curve for average depth by harbor.

Stage-damage relationships by harbor were compiled using average berth/slip depths and average mooring depth measurements for each harbor in Reach 3004. The average depth for Reach 3004 was used in calculations for the fleet mix in the "other" grouping. Comparison values for Reach 3004 are presented in Table G-40. Average annual damages (1980) for the adjusted Reach 3004 under

basis-of-comparison conditions totalled $22,100, 2.94 times greater than damages used in the analysis.

The remaining five sensitivity test results are shown in Table G-41. The second sensitivity test evaluated the effect of reconstructing the stage-damage curve for each reach. This was done by reassigning each change in damage to the water level where that damage is expected to first occur. In the procedure used in the base evaluation, damages were assigned to water levels corresponding to one-foot changes in available water depth.

Two additional sensitivity tests measured the effects of restricting the growth assumptions used in the analysis. One test used the assumption that growth continues to the base year of the project (1985). Another test was under the assumption that there is no growth (1980 conditions are held constant).

The last two sensitivity tests measured the effect of arbitrarily shifting the stage-damage curve 6 inches upwards and shifting the stage-damage curve downward 6 inches.

Table G-41 - Sensitivity Results to Benefits and Losses ($000)

	Base Case: Equivalent Average Annual Benefits (Growth to 2035)			Case 1: Existing Average Annual Benefits (W/Adjustment in Stage Damage Curve)			Case 2: Equivalent Average Annual Benefits (Growth to 1985)		
	6L	15S	25N	6L	15S	25N	6L	15S	25N
Lower System	61.16	67.49	96.09	33.70	45.72	71.89	56.81	62.79	89.39
Upper System	-510.31	-970.53	-3,076.47	-587.07	-1,024.39	-3,315.49	-488.94	-925.67	-2,943.59
Total	-449.15	-903.04	-2,980.38	-553.37	-978.67	-3,243.60	-432.13	-862.88	-2,854.20

	Case 3: Existing Average Annual Benefits 1980 Conditions (No Growth)			Case 4: Equivalent Average Annual Benefits (W/6" Downward Shift in Stage Damage Curve)			Case 5: Equivalent Average Annual Benefits (W/6" Upward Shift in Stage Damage Curve)		
	6L	15S	25N	6L	15S	25N	6L	15S	25N
Lower System	46.72	44.54	74.57	10.77	33.34	52.93	96.89	107.23	171.57
Upper System	-456.00	-855.42	-2,750.14	-244.73	-528.20	-1,796.55	-777.19	-1,530.67	-4,568.82
Total	-409.28	-810.88	-2,675.57	-233.96	-494.86	-1,743.62	-680.30	-1,423.44	-4,397.25

Annex A - Conversion Factors (British to Metric Units)

1 cubic foot per second (cfs) = 0.028317 cubic metres per second (cms)

1 cfs-month = 0.028317 cms-month

1 foot = 0.30480 metres

1 inch = 2.54 centimetres

1 mile (statute) = 1.6093 kilometres

1 ton (short) = 907.18 kilograms

1 square mile = 2.5900 square kilometres

1 cubic mile = 4.1682 cubic kilometres

Temperature in Celsius: $°C = (°F - 32)/1.8$

1 acre-feet = 1,233.5 cubic metres

1 gallon (U.S.) = 3.7853 litres

1 gallon (British) = 4.5459 litres

1 ton (long) = 1016.0 kilograms

Annex B - Recreational Beaches and Boating Group Membership

United States Section	Canadian Section
Ronald J. Guido, Chairman Corps of Engineers	Thomas Burton, Chairman Ontario Ministry of Natural Resources
Jonathan W. Brown Corps of Engineers	Jasmine T. Urisk Inland Waters Directorate, Ontario Region

Annex C - Significance Test as to the Impact of Proposed Regulation Plans on the Beaches of Lake Huron - Canadian Side

In its plan of action of 31 May 1978, the Environmental Effects Subcommittee directed that detailed evaluations be conducted on Lake Erie, Lake Ontario, and the Niagara River and St. Lawrence Rivers due to the potential for direct environmental impact by the regulation plans. The Subcommittee further stated, "As the impacts of regulation plans on the remaining Great Lakes and interconnecting channels are deemed to be limited, studies on those water bodies will likely be limited in nature . . ."

To more rigorously define the study area, a more formal test of the impact of regulation on the number of opportunities on the Lake Huron study area appeared to be warranted. This examination took the form of a hypothesis test for two dependent means, using the test statistic "t."

The objective of this test was to determine if there is a significant difference in the number of opportunities available on Lake Huron between the basis-of-comparison conditions and the regulation plan conditions. The test was run on three regulation plans. The three plans were selected to be representative of the potential maximum, minimum, and medium impacts, respectively, of the possible regulation plans on Lake Huron water levels.

The population tested was the 155 beaches of Lake Huron. A sample of 10 beaches was selected. Beaches were chosen to ensure adequate representation of the size and slope of the population.

Hydrographs for each regulation plan and the basis-of-comparison were obtained from the Regulation Subcommittee (see Appendix A, Lake Regulation). These hydrographs showed mean monthly levels for each year from 1900 to 1976, as well as the overall monthly means over the period of record. The overall monthly mean figures used for the purposes of this test, were run for each month in the defined recreation season, i.e., May to September. The monthly figures for each regulation plan were compared to the respective basis-of-comparison figures and the differences were used in the analysis.

The general hypothesis to be tested was that there is no significant difference between the number of opportunities available under basis-of-comparison conditions and regulation plan conditions. The calculation of additional opportunities was done for each beach using the calculation as described in Section 3.2.4.

For the purpose of the test, the hypotheses used were as follows:

1. null hypothesis: there is no significant difference between basis-of-comparison average levels and regulation plan average levels, i.e., H_0: rd = 0; and,

2. alternate hyphothesis: there is a significant difference between the basis-of-comparison average levels and the regulation plan average levels, i.e., H_2: rd = 0.

The test was run at the 95 percent confidence level. The value assigned was defined as being the risk or probability of rejecting the null hypothesis when it is actually true.

The value of "t" was determined as follows:

$$t = \frac{\bar{d} - rd}{s_d / \sqrt{n}}$$

Where n = number of data (population)

$\bar{d} = \frac{Ed}{n}$ = mean of the observed difference;

$s_d = \sqrt{\frac{n\Sigma(Ed^2) - (\Sigma Ed)^2}{n\,(n - 1)}}$ = standard deviation of the observed differences; and,

rd = mean difference of the data. For the purpose of the test $rd = 0$.

Using the above formula, a "t" value for each month was calculated and compared to the appropriate critical value from "Student's t-distribution" table. The null hypothesis will be rejected if the calculated value exceeds the critical value.

Procedure

Beaches were selected to ensure adequate representation of length and slope of the beaches in the population. Of the 155 beaches in the population tested, approximately 30 were examined for beach length and slope. The 10 beaches in Table 1 were representative of these beaches.

Following the selection of beaches to be used in the test, the hydrographs provided by the Regulation Subcommittee were examined with respect to their magnitude of impact in order to determine those plans having maximum, minimum, and medium impacts. As it was the intent of the study to examine the long-term implications of regulation, the average monthly means over the historic period of record were considered the most appropriate indicator of significance. As such, they were used in the examination of magnitude of impact, as well as in the calculations of "t" values.

In determining the magnitude of impact, each regulation plan was examined with respect to basis-of-comparison. Regulation plans considered to have maximum, minimum, and medium impacts, respectively, were:

1. Niagara River Structure, Plan 30N, 30,000 cfs maximum outflow;

2. Black Rock Canal Structure, Plan 15S2, 15,000 cfs maximum outflow; and

3. Black Rock Canal Structure, Plan 19S2, 19,000 cfs maximum outflow.

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LAKE ERIE WATER LEVEL STUDY. APPENDIX G. RECREATIONAL BEACHES A--ETC(U)
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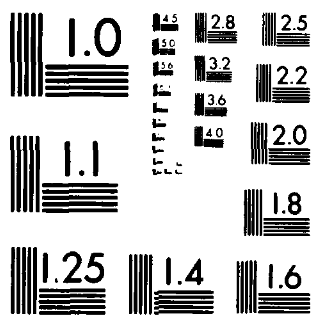


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table 1 - Sample Beaches for Definition of Study Area

Number	Name	Location	Length	Slope
1	Station	Bruce/Kincardine	554 m.	1.5
2	Bruce	Bruce/Huron	800 m.	1.5
3	Amberly	Huron/Ashfield	800 m.	1.5
4	Kintail	Huron/Ashfield	800 m.	1.5
5	Sunset	Huron/Colbourne	800 m.	1.5
6	St. Chris	Huron/Goderich	564 m.	1.5
7	Public	Lambton/Sarnia	460 m.	1.10
8	Harbour	Huron/Goderich	173 m.	1.10
9	Pine River	Bruce/Huron	400 m.	1.20
10	Public Access	Lambton/Bosanquet	650 m.	1.40

The test was run for each of the 5 months in the recreational season for each of the above regulation plans.

The water level value from the regulation plan hydrograph was subtracted from the basis-of-comparison value resulting in a value showing the vertical impact of regulation. This figure was then converted into a metric value and calculations proceeded on this basis. Vertical change was multiplied by the slope factor for each beach resulting in the additional beach width due to regulation. This figure was then multiplied by length of beach to arrive at additional beach area.

The "t" statistic was then calculated.

The following example shows the above calculation for Niagara River Structure, Plan 30N, for the month of May.

Table 2 - Sample Calculation for "t" Test

Beach Number	Vertical Change (m)	Slope Factor	Width Increase (m)	Beach Length (m)	Area Increase (m^2)	Increase in Opportunities
1	.0792	5	.396	554	219.38	10.49
2	.0792	5	.396	800	316.8	15.14
3	.0792	5	.396	800	316.8	25.74
4	.0792	5	.396	800	316.8	25.74
5	.0792	5	.396	800	316.8	25.74
6	.0792	5	.396	564	223.34	18.15
7	.0792	10	.792	460	364.32	40.15
8	.0792	10	.792	173	137.02	11.13
9	.0792	20	1.584	400	633.60	30.28
10	.0792	40	3.168	650	2,059.20	226.36

Data used (May example)
Basis-of-comparison water levels = 578.43 feet
Regulation plan water levels = 578.17 feet
Effect of regulation = .26 feet or .0792 meters
Space standard = 9.29 m^2
Turnover rate = 1.2
ICF = 3.70

Days available for beaches: 1, 2, 9 = 1.0
: 3, 6, 8 = 1.7
: 7, 10 = 2.3

$\bar{d}$ = 42.881, 52.78859

s_d = 65.1071, 60.97367

rd = 0

$\sqrt{n}$ = 3.16

The "t" value for regulation, Niagara River Structure, Plan 30N, for the month of May is 2.0812.

The "t" values were calculated for each regulation plan for each month and the results are listed in Table 3.

Table 3 - "t" Values for Each Regulation Plan for Each Month

	May	June	July	August	September
Niagara River Structure Plan 30N	2.0812	2.2291	2.5337	2.5141	2.14
Black Rock Structure Plan 19S2	2.0812	2.2291	2.5337	2.5141	2.14
Black Rock Structure Plan 15S2	2.0812	2.2291	2.5337	2.5141	2.14

The "t" values were then compared to the critical value found in the table of "Student's t-distribution." The critical value is 2.26.

Comparing this value to the above figures, the critical value is exceeded in the months of July and August for all regulation plans.

On the basis of this analysis, the char[illegible] opportunities is significant in July and August. An examination of [illegible]ial park attendance records show that beach use in this area dur[illegible] and August comprises from 69 percent to over 80 percent of annual beach use. It is obvious that major beach use occurs during this time and the significant impacts which occur warrant the inclusion of this area in the calculation of benefits. However, it was not included due to time and financial constraints.

Annex D - Detailed U.S. Inventory Data Results

Table 1

DRY BEACH MEASUREMENTS FOR ST. LAWRENCE (R008)
(AT THE SEASONAL MEAN)

	LENGTH				WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL		PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	4	0	4	NO. OF BEACHES	4	0	4
MEAN FT	601.	0.	601.	MEAN FT	138.	0.	138.
(METERS)	(183.)	(0.)	(183.)	(METERS)	(42.)	(0.)	(42.)
STD DEV FT.	263.	0.	263.	STD DEV FT.	59.	0.	59.
(METERS)	(80.)	(0.)	(80.)	(METERS)	(18.)	(0.)	(18.)
TOTAL FT.	2405.	0.	2405.				
(METERS)	(733.)	(0.)	(733.)				

	CHANGE IN WIDTH--FT(METERS)				TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL	WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-99.7 (-30.4)	-0.0 (0.0)	-99.7 (-30.4)	4	92352.5 (8579.5)	0.0 (0.0)	92352.5 (8579.5)
2	-49.9 (-15.2)	-0.0 (0.0)	-49.9 (-15.2)	2	212293.7 (19722.1)	0.0 (0.0)	212293.7 (19722.1)
1	-24.9 (-7.6)	-0.0 (0.0)	-24.9 (-7.6)	1	272264.3 (25293.4)	0.0 (0.0)	272264.3 (25293.4)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)	0	332234.9 (30864.6)	0.0 (0.0)	332234.9 (30864.6)
-1	24.9 (7.6)	-0.0 (0.0)	24.9 (7.6)	-1	392205.5 (36435.9)	0.0 (0.0)	392205.5 (36435.9)
-2	49.9 (15.2)	-0.0 (0.0)	49.9 (15.2)	-2	452176.1 (42007.2)	0.0 (0.0)	452176.1 (42007.2)
-4	99.7 (30.4)	-0.0 (0.0)	99.7 (30.4)	-4	572117.2 (53149.7)	0.0 (0.0)	572117.2 (53149.7)
-6	149.6 (45.6)	-0.0 (0.0)	149.6 (45.6)	-6	692058.4 (64292.2)	0.0 (0.0)	692058.4 (64292.2)

Table 2

DRY BEACH MEASUREMENTS FOR ST. LAWRENCE (R007)
(AT THE SEASONAL MEAN)

	LENGTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	0	0	0
MEAN FT	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)
STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)
TOTAL FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)

	WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	0	0	0
MEAN FT	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)
STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)

	CHANGE IN WIDTH--FT(METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
2	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
1	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-2	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-4	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-6	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)

	TOTAL AREA==SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
0	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-1	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-2	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-4	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-6	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

Table 3

DRY BEACH MEASUREMENTS FOR ST. LAWRENCE (R006)
(AT THE SEASONAL MEAN)

	LENGTH				WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL		PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	5	0	5	NO. OF BEACHES	4	0	4
MEAN FT	215.	0.	215.	MEAN FT	58.	0.	58.
(METERS)	(65.)	(0.)	(65.)	(METERS)	(18.)	(0.)	(18.)
STD DEV FT.	124.	0.	124.	STD DEV FT.	44.	0.	44.
(METERS)	(38.)	(0.)	(38.)	(METERS)	(13.)	(0.)	(13.)
TOTAL FT.	1074.	0.	1074.				
(METERS)	(327.)	(0.)	(327.)				

	CHANGE IN WIDTH--FT(METERS)				TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL	WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-90.8 (-27.7)	-0.0 (0.0)	-90.8 (-27.7)	4	-35326.3 (-3281.8)	0.0 (0.0)	-35326.3 (-3281.8)
2	-45.4 (-13.8)	-0.0 (0.0)	-45.4 (-13.8)	2	13445.5 (1249.1)	0.0 (0.0)	13445.5 (1249.1)
1	-22.7 (-6.9)	-0.0 (0.0)	-22.7 (-6.9)	1	37831.4 (3514.5)	0.0 (0.0)	37831.4 (3514.5)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)	0	62217.3 (5780.0)	0.0 (0.0)	62217.3 (5780.0)
-1	22.7 (6.9)	-0.0 (0.0)	22.7 (6.9)	-1	86603.2 (8045.4)	0.0 (0.0)	86603.2 (8045.4)
-2	45.4 (13.8)	-0.0 (0.0)	45.4 (13.8)	-2	110989.2 (10310.9)	0.0 (0.0)	110989.2 (10310.9)
-4	90.8 (27.7)	-0.0 (0.0)	90.8 (27.7)	-4	159761.0 (14841.8)	0.0 (0.0)	159761.0 (14841.8)
-6	136.3 (41.5)	-0.0 (0.0)	136.3 (41.5)	-6	208532.8 (19372.7)	0.0 (0.0)	208532.8 (19372.7)

Table 4

DRY BEACH MEASUREMENTS FOR LAKE ONTARIO (2005)
(AT THE SEASONAL MEAN)

	LENGTH				WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL		PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	4	0	4	NO. OF BEACHES	4	0	4
MEAN FT	384.	0.	384.	MEAN FT	47.	0.	47.
(METERS)	(117.)	(0.)	(117.)	(METERS)	(14.)	(0.)	(14.)
STD DEV FT.	271.	0.	271.	STD DEV FT.	31.	0.	31.
(METERS)	(83.)	(0.)	(83.)	(METERS)	(9.)	(0.)	(9.)
TOTAL FT.	1537.	0.	1537.				
(METERS)	(468.)	(0.)	(468.)				

	CHANGE IN WIDTH--FT(METERS)				TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL	WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-124.4 (-37.9)	-0.0 (0.0)	-124.4 (-37.9)	4	-119049.8 (-11059.7)	0.0 (0.0)	-119049.8 (-11059.7)
2	-62.2 (-19.0)	-0.0 (0.0)	-62.2 (-19.0)	2	-23476.6 (-2181.0)	0.0 (0.0)	-23476.6 (-2181.0)
1	-31.1 (-9.5)	-0.0 (0.0)	-31.1 (-9.5)	1	24310.0 (2258.4)	0.0 (0.0)	24310.0 (2258.4)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)	0	72096.7 (6697.8)	0.0 (0.0)	72096.7 (6697.8)
-1	31.1 (9.5)	-0.0 (0.0)	31.1 (9.5)	-1	119883.3 (11137.2)	0.0 (0.0)	119883.3 (11137.2)
-2	62.2 (19.0)	-0.0 (0.0)	62.2 (19.0)	-2	167669.9 (15576.5)	0.0 (0.0)	167669.9 (15576.5)
-4	124.4 (37.9)	-0.0 (0.0)	124.4 (37.9)	-4	263243.2 (24455.3)	0.0 (0.0)	263243.2 (24455.3)
-6	186.5 (56.9)	-0.0 (0.0)	186.5 (56.9)	-6	358816.4 (33334.0)	0.0 (0.0)	358816.4 (33334.0)

Table 5

DRY BEACH MEASUREMENTS FOR LAKE ONTARIO (2004)
(AT THE SEASONAL MEAN)

LENGTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	4	1	5
MEAN FT	1131.	2846.	1560.
(METERS)	(345.)	(867.)	(475.)
STD DEV FT.	621.	0.	996.
(METERS)	(189.)	(0.)	(304.)
TOTAL FT.	4524.	2846.	7799.
(METERS)	(1379.)	(867.)	(2377.)

WIDTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	3	1	4
MEAN FT	94.	81.	91.
(METERS)	(29.)	(25.)	(28.)
STD DEV FT.	29.	0.	25.
(METERS)	(9.)	(0.)	(8.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-208.9 (-63.7)	-136.6 (-41.6)	-190.8 (-58.2)
2	-104.4 (-31.8)	-68.3 (-20.8)	-95.4 (-29.1)
1	-52.2 (-15.9)	-34.1 (-10.4)	-47.7 (-14.5)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	52.2 (15.9)	34.1 (10.4)	47.7 (14.5)
-2	104.4 (31.8)	68.3 (20.8)	95.4 (29.1)
-4	208.9 (63.7)	136.6 (41.6)	190.8 (58.2)
-6	313.3 (95.5)	204.9 (62.4)	286.2 (87.2)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-518600.8 (-48178.0)	-157043.2 (-14589.3)	-778081.4 (-72283.8)
2	-46104.1 (-4283.1)	37310.6 (3466.2)	-34047.8 (-3163.0)
1	190144.2 (17664.4)	134487.5 (12493.9)	337969.0 (31397.3)
0	426392.5 (39611.9)	231664.4 (21521.6)	709985.8 (65957.7)
-1	662640.8 (61559.3)	328841.3 (30549.4)	1082002.6 (100518.0)
-2	898889.2 (83506.8)	426018.2 (39577.1)	1454019.4 (135078.4)
-4	1371385.8 (127401.7)	620372.0 (57632.6)	2198053.1 (204199.1)
-6	1843882.5 (171296.7)	814725.8 (75688.0)	2942086.7 (273319.9)

Table 6

DRY BEACH MEASUREMENTS FOR LAKE ONTARIO (2003)
(AT THE SEASONAL MEAN)

	LENGTH				WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL		PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	6	1	7	NO. OF BEACHES	4	0	4
MEAN FT	1016.	0.	1016.	MEAN FT	120.	0.	120.
(METERS)	(310.)	(0.)	(310.)	(METERS)	(37.)	(0.)	(37.)
STD DEV FT.	862.	0.	862.	STD DEV FT.	65.	0.	65.
(METERS)	(263.)	(0.)	(263.)	(METERS)	(20.)	(0.)	(20.)
TOTAL FT.	6096.	0.	7112.				
(METERS)	(1858.)	(0.)	(2168.)				

	CHANGE IN WIDTH--FT(METERS)				TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL	WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-186.4	-0.0	-186.4	4	-405951.5	0.0	-473610.1
	(-56.8)	(0.0)	(-56.8)		(-37712.9)	(0.0)	(-43998.4)
2	-93.2	-0.0	-93.2	2	162250.7	0.0	189292.4
	(-28.4)	(0.0)	(-28.4)		(15073.1)	(0.0)	(17585.3)
1	-46.6	-0.0	-46.6	1	446351.8	0.0	520743.7
	(-14.2)	(0.0)	(-14.2)		(41466.1)	(0.0)	(48377.1)
0	-0.0	-0.0	-0.0	0	730452.8	0.0	852195.0
	(0.0)	(0.0)	(0.0)		(67859.1)	(0.0)	(79168.9)
-1	46.6	-0.0	46.6	-1	1014553.9	0.0	1183646.3
	(14.2)	(0.0)	(14.2)		(94252.1)	(0.0)	(109960.7)
-2	93.2	-0.0	93.2	-2	1298655.0	0.0	1515097.5
	(28.4)	(0.0)	(28.4)		(120645.1)	(0.0)	(140752.6)
-4	186.4	-0.0	186.4	-4	1866857.2	0.0	2178000.1
	(56.8)	(0.0)	(56.8)		(173431.0)	(0.0)	(202336.2)
-6	279.6	-0.0	279.6	-6	2435059.4	0.0	2840902.6
	(85.2)	(0.0)	(85.2)		(226217.0)	(0.0)	(263919.9)

Table 7

DRY BEACH MEASUREMENTS FOR LAKE ONTARIO (2002)
(AT THE SEASONAL MEAN)

	LENGTH				WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL		PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	1	0	1	NO. OF BEACHES	1	0	1
MEAN FT	5130.	0.	5130.	MEAN FT	140.	0.	140.
(METERS)	(1564.)	(0.)	(1564.)	(METERS)	(43.)	(0.)	(43.)
STD DEV FT.	0.	0.	0.	STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)	(METERS)	(0.)	(0.)	(0.)
TOTAL FT.	5130.	0.	5130.				
(METERS)	(1564.)	(0.)	(1564.)				

	CHANGE IN WIDTH--FT(METERS)				TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL	WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-85.3 (-26.0)	-0.0 (0.0)	-85.3 (-26.0)	4	279925.7 (26005.1)	0.0 (0.0)	279925.7 (26005.1)
2	-42.6 (-13.0)	-0.0 (0.0)	-42.6 (-13.0)	2	498592.7 (46319.3)	0.0 (0.0)	498592.7 (46319.3)
1	-21.3 (-6.5)	-0.0 (0.0)	-21.3 (-6.5)	1	607926.2 (56476.3)	0.0 (0.0)	607926.2 (56476.3)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)	0	717259.7 (66633.4)	0.0 (0.0)	717259.7 (66633.4)
-1	21.3 (6.5)	-0.0 (0.0)	21.3 (6.5)	-1	826593.2 (76790.5)	0.0 (0.0)	826593.2 (76790.5)
-2	42.6 (13.0)	-0.0 (0.0)	42.6 (13.0)	-2	935926.7 (86947.6)	0.0 (0.0)	935926.7 (86947.6)
-4	85.3 (26.0)	-0.0 (0.0)	85.3 (26.0)	-4	1154593.7 (107261.8)	0.0 (0.0)	1154593.7 (107261.8)
-6	127.9 (39.0)	-0.0 (0.0)	127.9 (39.0)	-6	1373260.7 (127575.9)	0.0 (0.0)	1373260.7 (127575.9)

Table 8

DRY BEACH MEASUREMENTS FOR LAKE ONTARIO (2001)
(AT THE SEASONAL MEAN)

	LENGTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	6	1	7
MEAN FT	768.	410.	717.
(METERS)	(234.)	(125.)	(218.)
STD DEV FT.	545.	0.	516.
(METERS)	(166.)	(0.)	(157.)
TOTAL FT.	4608.	410.	5018.
(METERS)	(1405.)	(125.)	(1529.)

	WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	6	1	7
MEAN FT	91.	14.	80.
(METERS)	(28.)	(4.)	(24.)
STD DEV FT.	72.	0.	72.
(METERS)	(22.)	(0.)	(22.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-69.0 (-21.0)	-62.6 (-19.1)	-68.1 (-20.8)
2	-34.5 (-10.5)	-31.3 (-9.5)	-34.1 (-10.4)
1	-17.3 (-5.3)	-15.7 (-4.8)	-17.0 (-5.2)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	17.3 (5.3)	15.7 (4.8)	17.0 (5.2)
-2	34.5 (10.5)	31.3 (9.5)	34.1 (10.4)
-4	69.0 (21.0)	62.6 (19.1)	68.1 (20.8)
-6	103.6 (31.6)	93.9 (28.6)	102.2 (31.1)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	101885.5 (9465.2)	-20013.3 (-1859.2)	60108.8 (5584.1)
2	260945.7 (24241.9)	-7178.7 (-666.9)	231017.3 (21461.5)
1	340475.8 (31630.2)	-761.4 (-70.7)	316471.5 (29400.2)
0	420005.9 (39018.6)	5655.9 (525.4)	401925.8 (37338.9)
-1	499536.0 (46406.9)	12073.2 (1121.6)	487380.1 (45277.6)
-2	579066.2 (53795.2)	18490.6 (1717.8)	572834.3 (53216.3)
-4	738126.4 (68571.9)	31325.2 (2910.1)	743742.8 (69093.7)
-6	897186.6 (83348.6)	44159.8 (4102.4)	914651.3 (84971.1)

Table 9

DRY BEACH MEASUREMENTS FOR NIAGARA RIVER(R005)
(AT THE SEASONAL MEAN)

LENGTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	0	0	0
MEAN FT	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)
STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)
TOTAL FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)

WIDTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	0	0	0
MEAN FT	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)
STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
2	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
1	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-2	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-4	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-6	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
0	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-1	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-2	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-4	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
-6	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

Table 10

DRY BEACH MEASUREMENTS FOR NIAGARA RIVER(R004)
(AT THE SEASONAL MEAN)

	LENGTH				WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL		PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	2	0	2	NO. OF BEACHES	1	0	1
MEAN FT	1010.	0.	1010.	MEAN FT	148.	0.	148.
(METERS)	(308.)	(0.)	(308.)	(METERS)	(45.)	(0.)	(45.)
STD DEV FT.	0.	0.	0.	STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)	(METERS)	(0.)	(0.)	(0.)
TOTAL FT.	2020.	0.	2020.				
(METERS)	(616.)	(0.)	(616.)				

	CHANGE IN WIDTH--FT(METERS)				TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL	WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-200.3 (-61.0)	-0.0 (0.0)	-200.3 (-61.0)	4	-106008.4 (-9848.2)	0.0 (0.0)	-106008.4 (-9848.2)
2	-100.1 (-30.5)	-0.0 (0.0)	-100.1 (-30.5)	2	96269.6 (8943.4)	0.0 (0.0)	96269.6 (8943.4)
1	-50.1 (-15.3)	-0.0 (0.0)	-50.1 (-15.3)	1	197408.6 (18339.3)	0.0 (0.0)	197408.6 (18339.3)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)	0	298547.6 (27735.1)	0.0 (0.0)	298547.6 (27735.1)
-1	50.1 (15.3)	-0.0 (0.0)	50.1 (15.3)	-1	399686.6 (37130.9)	0.0 (0.0)	399686.6 (37130.9)
-2	100.1 (30.5)	-0.0 (0.0)	100.1 (30.5)	-2	500825.6 (46526.7)	0.0 (0.0)	500825.6 (46526.7)
-4	200.3 (61.0)	-0.0 (0.0)	200.3 (61.0)	-4	703103.6 (65318.3)	0.0 (0.0)	703103.6 (65318.3)
-6	300.4 (91.6)	-0.0 (0.0)	300.4 (91.6)	-6	905381.6 (84109.9)	0.0 (0.0)	905381.6 (84109.9)

Table 11

DRY BEACH MEASUREMENTS FOR LAKE ERIE (3004)
(AT THE SEASONAL MEAN)

LENGTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	21	15	36
MEAN FT	2032.	651.	1530.
(METERS)	(619.)	(199.)	(466.)
STD DEV FT.	4770.	445.	3839.
(METERS)	(1454.)	(136.)	(1170.)
TOTAL FT.	42674.	9771.	55081.
(METERS)	(13007.)	(2978.)	(16789.)

WIDTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	20	12	32
MEAN FT	119.	85.	106.
(METERS)	(36.)	(26.)	(32.)
STD DEV FT.	52.	49.	53.
(METERS)	(16.)	(15.)	(16.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-135.2 (-41.2)	-116.9 (-35.6)	-128.1 (-39.0)
2	-67.6 (-20.6)	-58.4 (-17.8)	-64.1 (-19.5)
1	-33.8 (-10.3)	-29.2 (-8.9)	-32.0 (-9.8)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	33.8 (10.3)	29.2 (8.9)	32.0 (9.8)
-2	67.6 (20.6)	58.4 (17.8)	64.1 (19.5)
-4	135.2 (41.2)	116.9 (35.6)	128.1 (39.0)
-6	202.8 (61.8)	175.3 (53.4)	192.2 (58.6)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-693016.2 (-64381.2)	-315458.0 (-29306.0)	-1213714.2 (-112754.0)
2	2191533.9 (203593.5)	255599.0 (23745.1)	2314347.5 (215002.9)
1	3633808.9 (337580.8)	541127.5 (50270.7)	4078378.4 (378881.3)
0	5076083.9 (471568.2)	826656.0 (76796.3)	5842409.2 (542759.8)
-1	6518358.9 (605555.5)	1112184.5 (103321.9)	7606440.0 (706638.3)
-2	7960633.9 (739542.9)	1397712.9 (129847.5)	9370470.9 (870516.7)
-4	10845184.0 (1007517.6)	1968769.9 (182898.7)	12898532.5 (1198273.7)
-6	13729734.0 (1275492.3)	2539826.9 (235949.9)	16426594.2 (1526030.6)

Table 12

DRY BEACH MEASUREMENTS FOR LAKE ERIE (3003)
(AT THE SEASONAL MEAN)

	LENGTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	31	49	80
MEAN FT	969.	647.	781.
(METERS)	(295.)	(197.)	(238.)
STD DEV FT.	991.	447.	735.
(METERS)	(302.)	(136.)	(224.)
TOTAL FT.	30032.	31686.	62509.
(METERS)	(9154.)	(9658.)	(19053.)

	WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	23	32	55
MEAN FT	98.	44.	67.
(METERS)	(30.)	(13.)	(20.)
STD DEV FT.	83.	21.	62.
(METERS)	(25.)	(6.)	(19.)

	CHANGE IN WIDTH--FT(METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-92.7 (-28.3)	-71.8 (-21.9)	-80.9 (-24.7)
2	-46.4 (-14.1)	-35.9 (-10.9)	-40.5 (-12.3)
1	-23.2 (-7.1)	-18.0 (-5.5)	-20.2 (-6.2)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	23.2 (7.1)	18.0 (5.5)	20.2 (6.2)
-2	46.4 (14.1)	35.9 (10.9)	40.5 (12.3)
-4	92.7 (28.3)	71.8 (21.9)	80.9 (24.7)
-6	139.1 (42.4)	107.7 (32.8)	121.4 (37.0)

	TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	170633.6 (15851.9)	-876148.8 (-81394.2)	-877749.0 (-81542.9)
2	1563290.1 (145229.7)	261735.8 (24315.3)	1650790.0 (153358.4)
1	2259618.4 (209918.5)	830678.1 (77170.0)	2915059.5 (270809.0)
0	2955946.7 (274607.4)	1399620.4 (130024.7)	4179329.0 (388259.7)
-1	3652274.9 (339296.3)	1968562.6 (182879.5)	5443598.5 (505710.3)
-2	4348603.2 (403985.2)	2537504.9 (235734.2)	6707868.0 (623160.9)
-4	5741259.8 (533363.0)	3675389.5 (341443.7)	9236407.0 (858062.2)
-6	7133916.3 (662740.8)	4813274.0 (447153.2)	11764946.1 (1092963.5)

Table 13

DRY BEACH MEASUREMENTS FOR LAKE ERIE (3002)
(AT THE SEASONAL MEAN)

LENGTH	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	9	6	15
MEAN FT	966.	684.	879.
(METERS)	(295.)	(208.)	(268.)
STD DEV FT.	1054.	626.	926.
(METERS)	(321.)	(191.)	(282.)
TOTAL FT.	8696.	4104.	13191.
(METERS)	(2651.)	(1251.)	(4021.)

WIDTH	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	9	3	12
MEAN FT	96.	102.	98.
(METERS)	(29.)	(31.)	(30.)
STD DEV FT.	34.	103.	53.
(METERS)	(10.)	(32.)	(16.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-243.0 (-74.1)	-126.7 (-38.6)	-213.9 (-65.2)
2	-121.5 (-37.0)	-63.3 (-19.3)	-107.0 (-32.6)
1	-60.7 (-18.5)	-31.7 (-9.7)	-53.5 (-16.3)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	60.7 (18.5)	31.7 (9.7)	53.5 (16.3)
-2	121.5 (37.0)	63.3 (19.3)	107.0 (32.6)
-4	243.0 (74.1)	126.7 (38.6)	213.9 (65.2)
-6	364.5 (111.1)	190.0 (57.9)	320.9 (97.8)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-1274611.6 (-118411.4)	-101392.8 (-9419.4)	-1531544.9 (-142280.5)
2	-218132.0 (-20264.5)	158532.2 (14727.6)	-120774.1 (-11219.9)
1	310107.9 (28809.0)	288494.6 (26801.2)	584611.2 (54310.4)
0	838347.7 (77882.5)	418457.1 (38874.7)	1289996.6 (119840.7)
-1	1366587.5 (126956.0)	548419.6 (50948.2)	1995382.0 (185371.0)
-2	1894827.3 (176029.5)	678382.1 (63021.7)	2700767.3 (250901.3)
-4	2951307.0 (274176.4)	938307.0 (87168.7)	4111538.1 (381961.9)
-6	4007786.7 (372323.4)	1198232.0 (111315.8)	5522308.8 (513022.5)

Table 14

DRY BEACH MEASUREMENTS FOR LAKE ERIE (3001)
(AT THE SEASONAL MEAN)

LENGTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	1	1	2
MEAN FT	1010.	296.	653.
(METERS)	(308.)	(90.)	(199.)
STD DEV FT.	0.	0.	505.
(METERS)	(0.)	(0.)	(154.)
TOTAL FT.	1010.	296.	1306.
(METERS)	(308.)	(90.)	(398.)

WIDTH

	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	1	1	2
MEAN FT	192.	86.	139.
(METERS)	(58.)	(26.)	(42.)
STD DEV FT.	0.	0.	75.
(METERS)	(0.)	(0.)	(23.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-157.9 (-48.1)	-200.0 (-61.0)	-179.0 (-54.6)
2	-79.0 (-24.1)	-100.0 (-30.5)	-89.5 (-27.3)
1	-39.5 (-12.0)	-50.0 (-15.2)	-44.7 (-13.6)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	39.5 (12.0)	50.0 (15.2)	44.7 (13.6)
-2	79.0 (24.1)	100.0 (30.5)	89.5 (27.3)
-4	157.9 (48.1)	200.0 (61.0)	179.0 (54.6)
-6	236.9 (72.2)	300.1 (91.5)	268.5 (81.8)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	34252.2 (3182.0)	-33877.9 (-3147.3)	-52592.1 (-4885.8)
2	114014.6 (10592.0)	-4271.9 (-396.9)	64290.1 (5972.6)
1	153895.8 (14296.9)	10531.0 (978.3)	122731.3 (11401.7)
0	193777.0 (18001.9)	25334.0 (2353.5)	181172.4 (16830.9)
-1	233658.2 (21706.8)	40136.9 (3728.7)	239613.5 (22260.1)
-2	273539.4 (25411.8)	54939.9 (5103.9)	298054.6 (27689.3)
-4	353301.9 (32821.7)	84545.8 (7854.3)	414936.8 (38547.6)
-6	433064.3 (40231.7)	114151.7 (10604.7)	531819.1 (49406.0)

Table 15

DRY BEACH MEASUREMENTS FOR DETROIT RIVER (R003)
(AT THE SEASONAL MEAN)

	LENGTH				WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL		PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	1	0	1	NO. OF BEACHES	1	0	1
MEAN FT	1094.	0.	1094.	MEAN FT	131.	0.	131.
(METERS)	(333.)	(0.)	(333.)	(METERS)	(40.)	(0.)	(40.)
STD DEV FT.	0.	0.	0.	STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)	(METERS)	(0.)	(0.)	(0.)
TOTAL FT.	1094.	0.	1094.				
(METERS)	(333.)	(0.)	(333.)				

	CHANGE IN WIDTH--FT(METERS)				TOTAL AREA--SQ FT(SQ METERS)		
WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL	WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-150.1 (-45.7)	-0.0 (0.0)	-150.1 (-45.7)	4	-20914.1 (-1942.9)	0.0 (0.0)	-20914.1 (-1942.9)
2	-75.0 (-22.9)	-0.0 (0.0)	-75.0 (-22.9)	2	61165.1 (5682.2)	0.0 (0.0)	61165.1 (5682.2)
1	-37.5 (-11.4)	-0.0 (0.0)	-37.5 (-11.4)	1	102204.6 (9494.8)	0.0 (0.0)	102204.6 (9494.8)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)	0	143244.2 (13307.4)	0.0 (0.0)	143244.2 (13307.4)
-1	37.5 (11.4)	-0.0 (0.0)	37.5 (11.4)	-1	184283.8 (17120.0)	0.0 (0.0)	184283.8 (17120.0)
-2	75.0 (22.9)	-0.0 (0.0)	75.0 (22.9)	-2	225323.4 (20932.5)	0.0 (0.0)	225323.4 (20932.5)
-4	150.1 (45.7)	-0.0 (0.0)	150.1 (45.7)	-4	307402.6 (28557.7)	0.0 (0.0)	307402.6 (28557.7)
-6	225.1 (68.6)	-0.0 (0.0)	225.1 (68.6)	-6	389481.7 (36182.9)	0.0 (0.0)	389481.7 (36182.9)

Table 16

DRY BEACH MEASUREMENTS FOR LAKE ST CLAIR (R002)
(AT THE SEASONAL MEAN)

LENGTH	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	4	0	4
MEAN FT	644.	0.	644.
(METERS)	(196.)	(0.)	(196.)
STD DEV FT.	904.	0.	904.
(METERS)	(276.)	(0.)	(276.)
TOTAL FT.	2575.	0.	2575.
(METERS)	(785.)	(0.)	(785.)

WIDTH	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	4	0	4
MEAN FT	116.	0.	116.
(METERS)	(35.)	(0.)	(35.)
STD DEV FT.	39.	0.	39.
(METERS)	(12.)	(0.)	(12.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-154.2 (-47.0)	-0.0 (0.0)	-154.2 (-47.0)
2	-77.1 (-23.5)	-0.0 (0.0)	-77.1 (-23.5)
1	-38.5 (-11.7)	-0.0 (0.0)	-38.5 (-11.7)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	38.5 (11.7)	-0.0 (0.0)	38.5 (11.7)
-2	77.1 (23.5)	-0.0 (0.0)	77.1 (23.5)
-4	154.2 (47.0)	-0.0 (0.0)	154.2 (47.0)
-6	231.3 (70.5)	-0.0 (0.0)	231.3 (70.5)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-98217.8 (-9124.4)	0.0 (0.0)	-98217.8 (-9124.4)
2	100310.4 (9318.8)	0.0 (0.0)	100310.4 (9318.8)
1	199574.5 (18540.5)	0.0 (0.0)	199574.5 (18540.5)
0	298838.6 (27762.1)	0.0 (0.0)	298838.6 (27762.1)
-1	398102.8 (36983.7)	0.0 (0.0)	398102.8 (36983.7)
-2	497366.9 (46205.4)	0.0 (0.0)	497366.9 (46205.4)
-4	695895.1 (64648.7)	0.0 (0.0)	695895.1 (64648.7)
-6	894423.3 (83091.9)	0.0 (0.0)	894423.3 (83091.9)

Table 17

DRY BEACH MEASUREMENTS FOR ST CLAIR RIVER(R001)
(AT THE SEASONAL MEAN)

	LENGTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	0	1	1
MEAN FT	0.	65.	65.
(METERS)	(0.)	(20.)	(20.)
STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)
TOTAL FT.	0.	65.	65.
(METERS)	(0.)	(20.)	(20.)

	WIDTH		
	PUBLIC AND COMMUNITY	OTHER	TOTAL
NO. OF BEACHES	0	1	1
MEAN FT	0.	-6.	-6.
(METERS)	(0.)	(-2.)	(-2.)
STD DEV FT.	0.	0.	0.
(METERS)	(0.)	(0.)	(0.)

CHANGE IN WIDTH--FT(METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	-0.0 (0.0)	-147.6 (-45.0)	-147.6 (-45.0)
2	-0.0 (0.0)	-73.8 (-22.5)	-73.8 (-22.5)
1	-0.0 (0.0)	-36.9 (-11.2)	-36.9 (-11.2)
0	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.0)
-1	-0.0 (0.0)	36.9 (11.2)	36.9 (11.2)
-2	-0.0 (0.0)	73.8 (22.5)	73.8 (22.5)
-4	-0.0 (0.0)	147.6 (45.0)	147.6 (45.0)
-6	-0.0 (0.0)	221.3 (67.5)	221.3 (67.5)

TOTAL AREA--SQ FT(SQ METERS)

WATER LEVEL CHANGE (FT)	PUBLIC AND COMMUNITY	OTHER	TOTAL
4	0.0 (0.0)	-9999.8 (-929.0)	-9999.8 (-929.0)
2	0.0 (0.0)	-5204.3 (-483.5)	-5204.3 (-483.5)
1	0.0 (0.0)	-2806.5 (-260.7)	-2806.5 (-260.7)
0	0.0 (0.0)	-408.7 (-38.0)	-408.7 (-38.0)
-1	0.0 (0.0)	1989.0 (184.8)	1989.0 (184.8)
-2	0.0 (0.0)	4386.8 (407.5)	4386.8 (407.5)
-4	0.0 (0.0)	9182.3 (853.0)	9182.3 (853.0)
-6	0.0 (0.0)	13977.8 (1298.5)	13977.8 (1298.5)

Annex E - Institutional Constraint Factor Calculations

This annex contains institutional constraint factor calculations for the following:

Holiday Beach

Wheatley

Rondeau

Iroquois Beach

Long Point

Selkirk

Rock Point

Bronte Creek

Darlington

Presquile

North Beach

Outlet Beach

PARK NAME: Holiday
MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1492.8	81.6	148.8	506.4	326.4	859.2	2683.2	'76
2731.2	566.4	470.4	480	1152	3916.8	9340.8	'77
3494.4	417.6	657.6	489.6	984.	2472.	6691.2	'78
7718.4	1065.6	1276.8	1176.0	2462.4	7248	18715.	Total

Divide each daily total by the largest daily total

.412	.057	.068	.062	.131	.387	1.0

Sum these seven numbers and divide by 7

$\frac{2.117}{7}$ = .3024 monthly I.C.F.

PARK NAME: __________
MONTH: __________

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\_\_\_\_}{7}$ = ______ monthly I.C.F.

PARK NAME: Holiday
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
3794.4	2399.4	3168.2	2883.	2145.2	4836.	22735.1	'76
2759.	2356	6020.	3106.2	4371.	6510	30609.4	'77
2163.8	3093.8	5815.6	2870.6	2920.2	7278.8	21749.6	'78
8717.2	7849.2	15003.8	8859.8	9436.4	18624.8	75094.4	Total

Divide each daily total by the largest daily total

.116	.104	.199	.118	.126	.248	1.0

Sum these seven numbers and divide by 7

$\frac{1.911}{7}$ = .273 monthly I.C.F.

PARK NAME: Holiday
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1092.	1825.2	1253.2	1003.6	1076.4	6853.6	18517.2	'76
982.8	878.8	1502.8	1502.8	993.2	3125.2	14690.	'77
717.6	1450.8	1237.6	1851.2	1560.	5896.8	19598.8	'78
2792.4	4154.8	3993.6	4357.6	3629.6	15875.6	52806.	Total

Divide each daily total by the largest daily total

.053	.079	.076	.083	.069	.301	1.0

Sum these seven numbers and divide by 7

$\frac{1.661}{7}$ = .2372 monthly I.C.F.

PARK NAME: Holiday Beach
MONTH: Sept

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1229.6	—	46.4	87	133.4	377	875.8	'76
788.8	—	—	156.6	145	527.8	1357.2	'77
1757.4	—	—	—	348	620.6	2447.6	'78
3775.8	—	46.4	243.6	626.4	1525.4	4680.6	Total

Divide each daily total by the largest daily total

.807	—	.010	.050	.134	.326	1.0

Sum these seven numbers and divide by 7

$\frac{2.327}{7}$ = .3324 monthly I.C.F.

PARK NAME: Holiday
MONTH: Aug

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
2028	1932	2268	1134	1104	2058	12600	'76
1842	900	834	996	966	1704	7476	'77
1638	2532	2124	1638	1764	3420	14976	'78
5508	5364	5226	5736	3834	7182	35052	Total

Divide each daily total by the largest daily total

.157	.153	.149	.164	.109	.205	1.0

Sum these seven numbers and divide by 7

$\frac{1.937}{7}$ = .2767 monthly I.C.F.

PARK NAME: Wheatley
MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
795.5	11.1	7.4	259.0	691.9	1576.2	2490.1	'76
592.	1036	62.9	111	148	910.2	2356.9	'77
247.9	29.6	44.4	51.8	148	558.7	1143.3	'78
1635.4	144.3	114.7	421.8	987.9	3045.1	5990.3	Total

Divide each daily total by the largest daily total

.273	.024	.019	.070	.150	.508	1.0

Sum these seven numbers and divide by 7

$\frac{2.044}{7}$ = .2920 monthly I.C.F.

PARK NAME: Wheatley
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
281.2	—	81.4	1209.9	991.6	588.3	4234.9	'76
288.6	222.	403.3	466.2	762.2	1576.2	4292	'77
225.7	255.3	292.3	247.9	466.2	880.6	3063.6	'78
795.5	477.3	777.	1924.	2220.	3045.1	11590.5	Total

Divide each daily total by the largest daily total

.069	.041	.067	.166	.192	.263	1.0

Sum these seven numbers and divide by 7

$\frac{1.798}{7}$ = .2569 monthly I.C.F.

PARK NAME:
MONTH:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

—— / 7 = —— monthly I.C.F.

PARK NAME: Wheatley
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
780.7	—	22.2	29.6	155.4	621.6	3755.5	'76
159.1	155.4	188.7	129.5	414.4	444.	1287.6	'77
48.1	77.7	88.8	203.5	173.9	606.8	2142.3	'78
987.9	233.1	299.7	362.6	743.7	1672.4	7167.4	Total

Divide each daily total by the largest daily total

.138	.033	.042	.051	.104	.233	1.0

Sum these seven numbers and divide by 7

$\frac{1.601}{7}$ = .2287 monthly I.C.F.

PARK: Wheatley
MONTH: Sept

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
429.2	—	—	140.6	55.5	—	1032.3	'76
233.1	173.9	22.2	40.7	111.	210.9	592.	'77
301.1	—	—	—	38.8	173.9	643.8	'78
969.4	173.9	22.2	181.3	205.3	375.8	2268.1	Total

Divide each daily total by the largest daily total

.427	.077	.010	.080	.091	.166	1.0

Sum these seven numbers and divide by 7

$\frac{1.851}{7}$ = .2644 monthly I.C.F.

PARK NAME: Rondeau
MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1641	99.	261	393	771	3093	5448	'76
2001	390	420	306	1143	4245	8250	'77
1914	276	.252	387	939	2571	5085	'78
5556	765	933	1086	2853	9909	18783	Total

Divide each daily total by the largest daily total

.295	.041	.049	.058	.152	.527	1.0

Sum these seven numbers and divide by 7

$\frac{2.122}{7}$ = .3031 monthly I.C.F.

PARK NAME: Wheatley
MONTH: Aug.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
777.	310.8	22.2	884.3	222.	847.3	2179.3	'76
506.9	266.4	270.1	236.8	192.4	492.1	1209.9	'77
266.4	340.4	296.	292.3	281.2	680.8	2453.1	'78
1550.3	917.6	588.3	1413.4	695.6	2020.2	5842.3	Total

Divide each daily total by the largest daily total

.265	.157	.100	.241	.119	.345	1.0

Sum these seven numbers and divide by 7

$\frac{2.227}{7}$ = .3181 monthly I.C.F.

PARK NAME:
MONTH:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\quad}{7}$ = ______ monthly I.C.F.

PARK NAME: Rondeau
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1812	1374	1725	1929	2589	5295	9210	'76
1806	1539	2541	1695	3549	6009	11679	'77
2070	1560	1536	1200	1164	5643	8808	'78
5688	4473	5802	4824	7302	16947	18697	Total

Divide each daily total by the largest daily total

.304	.239	.310	.258	.391	.906	1.0

Sum these seven numbers and divide by 7

3.408 / 7 = .4869 monthly I.C.F.

PARK NAME: Rondeau
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
555	798	756	345	897	2787	7800	'76
582	576	804	735	561	2478	5922	'77
387	624	564	606	1086	2427	6543	'78
1524	1279	2124	1686	2544	7692	20[illegible]	Total

Divide each daily total by the largest daily total

.075	.063	.105	.083	.125	.379	1.0

Sum these seven numbers and divide by 7

1.83 / 7 = .2614 monthly I.C.F.

PARK NAME: Rondeau
MONTH: Sept

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1380	201	348	201	309	177	2580	'76
1152	297	189	288	294	1257	2598	'77
1314	261	150	120	846	1710	3789	'78
3846	759	687	609	1449	3144	8967	Total

Divide each daily total by the largest daily total

.429	.085	.077	.068	.162	.351	1.0

Sum these seven numbers and divide by 7

3.63 / 7 = .5186 monthly I.C.F.

PARK NAME: Rondeau
MONTH: Aug

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
2814	2001	1476	1248	1482	4161	3201	'76
2076	1512	1371	1452	1440	2523	5106	'77
1146	1968	1590	1716	1146	3783	8037	'78
6036	5481	4437	4413	4068	10467	16614	Total

Divide each daily total by the largest daily total

.363	.030	.267	.266	.245	.630	1.0

Sum these seven numbers and divide by 7

2.801 / 7 = .4001 monthly I.C.F.

PARK NAME: Iroquois
MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
17	—	—	—	3.4	153	221	'76
129.5	129.5	—	—	29.6	114.7	495.8	'77
94.5	—	—	—	10.5	66.8	66.5	'78
241.	129.5	—	—	43.5	334.2	783.3	Total

Divide each daily total by the largest daily total

.307	.165	0	0	.055	.427	1.0

Sum these seven numbers and divide by 7

$\frac{1.954}{7}$ = .2791 monthly I.C.F.

PARK NAME: Iroquois
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
214.2	173.4	190.4	241.4	316.2	744.6	2128.4	'76
222.	170.2	462.5	240.5	458.8	1084.1	2623.3	'77
129.5	234.5	175.	255.5	220.5	924.0	1813.	'78
565.7	578.1	827.9	737.4	995.9	2752.7	6564.7	Total

Divide each daily total by the largest daily total

.086	.088	.126	.112	.152	.419	1.0

Sum these seven numbers and divide by 7

$\frac{1.983}{7}$ = .2833 monthly I.C.F.

PARK NAME:
MONTH:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\quad}{7}$ = ______ monthly I.C.F.

PARK NAME: Iroquois
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
3.4	—	47.6	10.2	13.6	251.6	911.2	'76
48.1	37.	18.5	40.7	59.2	273.8	999	'77
7	—	28	14.0	105	150.5	738.5	'78
58.5	37	94.1	64.9	177.8	675.9	2648.7	Total

Divide each daily total by the largest daily total

.022	.014	.035	.024	.067	.255	1.0

Sum these seven numbers and divide by 7

$\frac{1.417}{7}$ = .1428 monthly I.C.F.

PARK: LONG POINT
MONTH: JUNE

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
101.5	143.5	231.0	35.0	290.5	443.0	1123.0	1976
140.0	91.0	147.0	199.5	164.5	1193.5	2887.5	1977
35.0	133.0	126.0	112.0	297.5	917.0	3192.0	1978
276.5	367.5	504.0	346.5	752.5	2553.5	7202.5	Total

Divide each daily total by the largest daily total

.038	.051	.069	.048	.104	.354	1.0

Sum these seven numbers and divide by 7

1.664 / 7 = .237 monthly I.C.F.

PARK NAME: LONG POINT
MONTH: MAY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
297.5	—	3.5	3.5	126.0	542.5	1141.0	1976
584.5	17.5	—	38.5	385.0	1610.0	2432.5	1977
451.5	—	10.5	10.5	91.0	696.5	1459.5	1978
1333.5	17.5	14.0	52.5	602.0	2849.0	5033.0	Total

Divide each daily total by the largest daily total

.264	.003	.002	.010	.119	.566	1.0

Sum these seven numbers and divide by 7

1.964 / 7 = .280 monthly I.C.F.

PARK NAME: IROQUOIS
MONTH: SEPT

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
71.4		—	6.8	13.6	64.6	[illegible]	[illegible]
[illegible]		.	—	—	40.7	140.6	1977
143.5		.		14	14	199.5	1978
433.2	—	—	6.8	27.6	119.3	472.7	Total

Divide each daily total by the largest daily total

.916	.0	.0	.014	.058	.252	1.0

Sum these seven numbers and divide by 7

2.24 / 7 = .320 monthly I.C.F.

PARK NAME: IROQUOIS
MONTH: [illegible]

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
361.8	214.2	238.	125.8	170	425	1635.4	'76
296	166.5	136.9	107.3	151.7	336.7	725.2	'77
455	213.5	175.0	87.5	147	672.	1099	'78
1012.8	594.2	549.9	320.6	468.7	1433.7	3459.6	Total

Divide each daily total by the largest daily total

.293	.172	.159	.093	.135	.414	1.0

Sum these seven numbers and divide by 7

2.266 / 7 = .3237 monthly I.C.F.

PARK: LONG POINT
MONTH: AUGUST

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1186.5	249.0	1088.5	560.0	500.5	1414.0	4511.5	1976
850.5	546.0	539.0	458.5	402.5	994.0	2198.0	1977
591.5	504.0	623.0	388.5	525.0	1564.5	4588.5	1978
2628.5	1799.0	2250.5	1407.0	1428.0	3972.5	11298.0	Total

Divide each daily total by the largest daily total

.232	.159	.199	.124	.126	.351	1.0

Sum these seven numbers and divide by 7

$\frac{2.191}{7}$ = .313 monthly I.C.F.

PARK NAME: SELKIRK SHORE
MONTH: MAY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
17.5	—	—	3.5	7.0	52.5	269.5	[illegible]
168.0	24.5	3.5	10.5	17.5	213.5	514.5	[illegible]
80.5	3.5	3.5	7.0	10.5	115.5	245.0	[illegible]
266.0	28.0	7.0	21.0	35.0	381.5	1029.0	Total

Divide each daily total by the largest daily total

.258	.027	.006	.020	.034	.370	1.0

Sum these seven numbers and divide by 7

$\frac{1.715}{7}$ = .245 monthly I.C.F.

PARK NAME: LONG POINT
MONTH: JULY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
693.0	700.0	913.5	948.5	1018.5	2205.0	4350.5	1976
616.0	185.0	1204.0	249.0	1494.5	3258.5	2012.5	1977
651.0	633.5	805.0	668.5	570.5	3129.0	5389.0	1978
1960.0	1518.5	2922.5	2366.0	3083.5	8592.5	16,751.0	Total

Divide each daily total by the largest daily total

.117	.090	.174	.141	.184	.512	1.0

Sum these seven numbers and divide by 7

$\frac{2.218}{7}$ = .316 monthly I.C.F.

PARK NAME: LONG POINT
MONTH: SEPTEMBER

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
329.0	—	49.0	31.5	94.5	259.0	875.0	1976
212.0	—	—	108.5	17.5	528.5	242.0	1977
402.5	—	—	—	70.0	539.0	238.5	1978
948.5	—	49.0	140.0	182.0	1326.5	2355.5	Total

Divide each daily total by the largest daily total

.402	—	.020	.059	.077	.563	1.0

Sum these seven numbers and divide by 7

$\frac{2.121}{7}$ = .303 monthly I.C.F.

PARK NAME: SELKIRK, SIMCOE
MONTH: JULY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
156.0	112.0	108.0	168.0	132.0	480.0	[illegible]	1976
[illegible]	196.0	360.0	156.0	276.0	628.0	[illegible]	1977
[illegible]	88.0	168.0	152.0	[illegible]	[illegible]	[illegible]	1978
428.0	396.0	636.0	476.0	540.0	1680.0	[illegible]	Total

Divide each daily total by the largest daily total

.103	.084	.135	.101	.136	.240	1.0

Sum these seven numbers and divide by 7

$\frac{1.899}{7}$ = .271 monthly I.C.F.

PARK NAME: SELKIRK, SIMCOE
MONTH: JUNE

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
10.5	38.5	35.0	28.0	28.0	189.0	[illegible]	[illegible]
45.5	35.0	28.5	[illegible]	42.0	147.0	532.0	[illegible]
39.0	35.0	17.5	17.5	80.5	[illegible]	[illegible]	[illegible]
84.0	108.5	91.0	87.5	150.5	441.0	1886.5	Total

Divide each daily total by the largest daily total

.044	.057	.048	.046	.079	.233	1.0

Sum these seven numbers and divide by 7

$\frac{1.502}{7}$ = .215 monthly I.C.F.

PARK NAME: SELKIRK, SIMCOE
MONTH: SEPTEMBER

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
45.5	3.5	17.5	14.	21.	28.	213.5	1976
63	10.5	7.0	21.	14.	63.	143.5	1977
70.	10.5	7.0	—	14.	56.	147.	1978
178.5	24.5	31.5	35.	49.	147.	504.	Total

Divide each daily total by the largest daily total

.354	.048	.062	.069	.097	.291	1.0

Sum these seven numbers and divide by 7

$\frac{1.921}{7}$ = .274 monthly I.C.F.

PARK NAME: SELKIRK, SIMCOE
MONTH: AUGUST

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
456.	88.	168.	144.	96.	420.0	1124.0	1976
460.	76.	108	84.	88.	180.	644.0	1977
360.	144.	128.	92.	116.	228.	884.0	1978
1276.0	308.0	404.0	320.0	300.0	828.0	2652.0	Total

Divide each daily total by the largest daily total

.481	.116	.152	.120	.113	.312	1.0

Sum these seven numbers and divide by 7

$\frac{2.294}{7}$ = .327 monthly I.C.F.

PARK NAME: NIAGARA - ROCK POINT
MONTH: MAY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
45.5	—	3.5	3.5	14.	42.	129.5	'76
126.	—	—	14.	14.	164.5	325.5	'77
56.	31.5	7.0	14.	17.5	108.5	178.5	'78
227.5	31.5	10.5	31.5	45.5	315.0	633.5	Total

Divide each daily total by the largest daily total

.36	.05	.02	.05	.07	.50	1.0

Sum these seven numbers and divide by 7

$\frac{1.98}{7}$ = .2827 monthly I.C.F.

PARK NAME: NIAGARA - ROCK PT.
MONTH: JULY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
108.5	80.5	115.5	126.	119.	224.	1113.	'76
119.0	49.0	168.	91.	112.	504.	1613.5	'77
126.	294.0	105.	84.	98.	402.5	1102.5	'78
353.5	423.5	388.5	301.	329.	1130.5	3829.0	Total

Divide each daily total by the largest daily total

.09	.11	.10	.08	.09	.29	1.0

Sum these seven numbers and divide by 7

$\frac{1.7623}{7}$ = .2518 monthly I.C.F.

PARK NAME: NIAGARA
MONTH: JUNE

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
549.5	35.	17.0	31.5	21.0	31.5	185.5	'76
28.	24.5	28.	24.5	3.5	122.5	399.	'77
17.5	35.	24.5	31.5	59.5	77.0	882.	'78
595.	94.5	59.5	87.5	84.0	231.0	1466.5	Total

Divide each daily total by the largest daily total

.41	.06	.04	.06	.06	.16	1.0

Sum these seven numbers and divide by 7

$\frac{1.79}{7}$ = .2557 monthly I.C.F.

PARK NAME: NIAGARA
MONTH: AUGUST

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
140.	108.5	168.	91.	80.5	241.5	647.5	'76
143.5	101.5	101.5	80.5	91.	126.	588.	'77
126.	119.	91.	49.0	112.	686.	577.5	'78
409.5	329.	360.5	220.5	283.5	1053.5	1813.	Total

Divide each daily total by the largest daily total

.23	.18	.20	.12	.16	.58	1.0

Sum these seven numbers and divide by 7

$\frac{2.47}{7}$ = .3529 monthly I.C.F.

PARK NAME: Niagara - Rock Point
MONTH: Sept

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
80.5	24.5	21.	21.	14.	45.5	45.5	'76
101.5	3.5	7.	24.5	7.	56.	140.	'77
136.5	7.0	3.5	3.5	31.5	105.	91.	'78
318.5	35.	31.5	49.	52.5	206.5	276.5	Total

Divide each daily total by the largest daily total

1.0	.11	.10	.15	.16	.65	.87

Sum these seven numbers and divide by 7

3.04 / 7 = .4343 monthly I.C.F.

PARK NAME: Pickle Creek
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1620.5	21.	70.	70	80.5	2425.5	3146.	'76
1711.4	223.6	116.1	184.9	176.3	2906.8	8247.4	'77
3108.	361.2	226.8	151.2	138.6	2007.6	7077.	'78
3017.1	604.8	412.9	406.1	395.4	7339.9	18469.4	Total

Divide each daily total by the largest daily total

.16	.03	.02	.02	.02	.39	1.0

Sum these seven numbers and divide by 7

1.64 / 7 = .2348 monthly I.C.F.

PARK NAME:
MONTH:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

_____ / 7 = _____ monthly I.C.F.

PARK NAME: [illegible] Creek
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
578.1	653.3	559.3	723.8	441.8	3130.2	11510.3	
754.4	694.4	1251.2	786.6	800.4	4452.8	14876.4	
628.8	700.8	513.6	1161.6	1128.	7300.8	18532.8	
1961.3	2048.5	2324.1	2672.0	2370.2	14883.8	44919.5	Total

Divide each daily total by the largest daily total

.04	.05	.05	.06	.05	.33	1.0

Sum these seven numbers and divide by 7

1.58 / 7 = .2257 monthly I.C.F.

PARK NAME: Bronze Creek
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1017.	1201.5	1669.5	1534.5	1044.	2407.5	7047.	'76
1358.3	1447.6	1532.2	1259.6	3022.1	4366.3	12746.4	'77
3181.2	3559.6	3823.6	3449.6	2846.8	9213.6	26122.8	'78
5856.5	6208.7	7025.3	6243.7	6912.9	15987.4	45916.2	Total

Divide each daily total by the largest daily total

.13	.14	.15	.14	.15	.35	1.0

Sum these seven numbers and divide by 7

$\frac{2.06}{7}$ = .2943 monthly I.C.F.

PARK NAME: Bronze Creek
MONTH: Sept

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
2134.	—	127.6	404.8	281.6	2525.6	6393.2	'76
2257.	—	—	795.5	225.7	3326.3	7303.8	'77
3676.8	187.2	254.4	177.6	1003.2	7598.4	8246.4	'78
8067.8	187.2	382.0	1377.9	1510.5	13450.3	21943.4	Total

Divide each daily total by the largest daily total

.37	.01	.02	.06	.07	.613	1.0

Sum these seven numbers and divide by 7

$\frac{2.14}{7}$ = .3057 monthly I.C.F.

PARK NAME: Bronze Creek
MONTH: August

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
2631.2	1711.6	2125.2	1130.8	1135.2	2081.2	7651.6	'76
3611.	2580.6	2681.8	2548.4	2111.4	5096.8	14756.8	'77
4235.3	3243.1	3624.4	2271.4	2718.3	5723.6	20016.2	'78
10477.5	7535.3	8431.4	5950.6	5964.9	12901.6	42424.6	Total

Divide each daily total by the largest daily total

.25	.18	.20	.14	.14	.30	1.0

Sum these seven numbers and divide by 7

$\frac{2.21}{7}$ = .3157 monthly I.C.F.

PARK NAME:
MONTH:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\quad}{7}$ = ____ monthly I.C.F.

PARK: Oakwood
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
334.8	352.8	334.8	421.5	360.	1209.6	4010.4	'76
217.8	211.3	227.5	214.5	513.5	1010.8	4098.3	'77
502.4	400.	307.2	380.	451.2	2291.2	5129.6	'78
1055.	964.1	669.5	1016.8	1324.7	4511.6	13238.3	Total

Divide each daily total by the largest daily total

.08	.07	.05	.08	.10	.34	1.0

Sum these seven numbers and divide by 7

$\frac{2.44}{7}$ = .3486 monthly I.C.F.

PARK NAME: Oakwood
MONTH: August

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
613.8	406.1	520.8	288.3	201.	1246.2	2157.	'76
449.5	288.3	155.	170.5	117.8	353.4	1503.5	'77
471.	285	273.	255.	229.4	927.	2275.4	'78
1534.3	979.4	948.8	713.8	548.2	2526.6	5935.9	Total

Divide each daily total by the largest daily total

.26	.17	.16	.12	.09	.43	1.0

Sum these seven numbers and divide by 7

$\frac{2.23}{7}$ = .3186 monthly I.C.F.

PARK NAME: Oakwood
MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
140.6	222.	29.6	51.8	85.1	665.1	913.9	'76
762.3	89.1	59.4	66	122.1	2194.8	2640.	'77
624.	54	54	27	93	450	1524.	'78
1526.9	165.3	143.	144.8	300.3	3309.9	5077.9	Total

Divide each daily total by the largest daily total

.3	.03	.03	.03	.06	.65	1.0

Sum these seven numbers and divide by 7

$\frac{2.1}{7}$ = .3000 monthly I.C.F.

PARK NAME: Oakwood
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
199.8	247.9	259.	207.2	310.8	1657.6	4895.1	'76
153.7	846.5	133.4	127.6	107.3	742.4	2656.4	'77
115.6	170.	102.	193.8	197.2	1149.2	3791.	'78
469.1	1264.4	494.4	528.6	615.3	3549.2	11342.5	Total

Divide each daily total by the largest daily total

.03	.08	.03	.03	.04	.22	1.0

Sum these seven numbers and divide by 7

$\frac{1.43}{7}$ = .2043 monthly I.C.F.

PARK NAME: Presquile

MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
708	967.2	110	14.4	—	1754.4	175.2	'76
393.6	52.8	57.6	64.8	134.4	724.8	1809.6	'77
261.6	156.	57.6	14.4	88.8	364.8	964.4	'78
1363.2	1176.0	225.2	93.6	223.2	2844.	2949.2	Total

Divide each daily total by the largest daily total

.46	.40	.076	.03	.08	.96	1.0

Sum these seven numbers and divide by 7

$\frac{3.006}{7}$ = .4294 monthly I.C.F.

PARK NAME: Darlingside

MONTH: [illegible]

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
348	—	12	48	27.	81.	195	'76
240.	—	—	—	16.	371.2	457.6	'77
409.6	—	—	—	44.8	288.	416.	'78
997.6	—	12	48	87.8	740.2	1068.6	Total

Divide each daily total by the largest daily total

.93	—	.01	.05	.08	.69	1.0

Sum these seven numbers and divide by 7

$\frac{2.76}{7}$ = .3943 monthly I.C.F.

PARK NAME: ________

MONTH: ________

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\_\_\_}{7}$ = _____ monthly I.C.F.

PARK NAME: ________

MONTH: ________

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\_\_\_}{7}$ = _____ monthly I.C.F.

PARK NAME: Presquile
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
678.6	783.	930.9	875.8	843.9	1316.6	4132.5	'76
959.9	1287.6	1339.8	910.6	1305.	3109.	7012.2	'77
1122.9	8408	783.8	1048.8	743.9	2989.7	5526.2	'78
2761.8	2911.4	3054.5	2835.2	2892.8	7415.3	16670.9	Total

Divide each daily total by the largest daily total

.17	.17	.18	.17	.17	.45	1.0

Sum these seven numbers and divide by 7

$\frac{2.31}{7}$ = .3300 monthly I.C.F.

PARK NAME: Presquile
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
595.5	275.	945.	240	882.5	1272.5	6561.25	'76
249.2	308	277.2	249.2	179.2	1002.4	3080.	'77
152.6	298.9	219.4	279.8	257.6	671.	3847.8	'78
997.3	881.9	1441.6	769.	1319.3	2945.9	13489.1	Total

Divide each daily total by the largest daily total

.07	.07	.11	.06	.10	.22	1.0

Sum these seven numbers and divide by 7

$\frac{1.63}{7}$ = .2329 monthly I.C.F.

PARK NAME: Presquile
MONTH: Sept

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
163.	10.5	116.5	77.7	65.1	172.2	344.4	'7
191.4	37.7	14.5	188.5	75.4	379.9	881.6	'7
365.4	20.3	26.1	98.6	104.4	382.8	646.7	'7
619.8	68.5	157.1	364.8	244.9	934.9	1872.7	Total

Divide each daily total by the largest daily total

.33	.04	.08	.19	.13	.50	1.0

Sum these seven numbers and divide by 7

$\frac{2.27}{7}$ = .3243 monthly I.C.F.

PARK NAME: Presquile
MONTH: Aug

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1046.9	690.2	1029.5	617.7	501.7	1873.4	3703.3	'7
945.4	510.4	513.3	640.9	446.6	1055.6	2291.	'7
1519.6	1067.2	437.9	461.1	635.1	1780.6	4373.2	'7
3511.9	2267.8	1980.7	1719.7	1583.4	4709.6	10367.5	Total

Divide each daily total by the largest daily total

.34	.22	.19	.17	.15	.45	1.0

Sum these seven numbers and divide by 7

$\frac{2.52}{7}$ = .3600 monthly I.C.F.

PARK NAME: North Beach
MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
425.6	259.2	185.6	64.0	83.2	576.0	1721.6	1978
467.2	150.4	60.8	67.2	73.6	592.0	1472.0	1977
48.0	—	—	6.4	9.6	169.6	147.2	1976
940.8	409.6	246.4	137.6	1664	1337.6	3340.8	Total

Divide each daily total by the largest daily total

.28	.12	.07	.04	.50	.40	1.0

Sum these seven numbers and divide by 7

$\frac{2.41}{7}$ = .3443 monthly I.C.F.

PARK NAME: North Beach
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1560.9	1395.9	1118.7	1428.9	1161.6	3283.5	7279.8	1978
1158.3	1702.8	1653.3	904.2	1178.1	2679.6	8131.2	1977
946.0	2640.2	2795.0	1290.0	1259.9	1105.1	705.2	1976
3665.2	5738.9	5567.0	3623.1	3599.6	7068.2	16116.2	Total

Divide each daily total by the largest daily total

.23	.36	.35	.23	.22	.44	1.0

Sum these seven numbers and divide by 7

$\frac{2.83}{7}$ = .4043 monthly I.C.F.

PARK NAME: North Beach
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
775	507.2	265.0	403.5	340.0	935.0	3342.5	1978
450.0	342.5	197.5	202.5	112.5	505.0	1665.0	'77
—	384.2	346.8	421.6	255.0	1400.8	2791.4	'76
3275	1233.9	809.3	1026.6	707.5	2840.8	4748.9	Total

Divide each daily total by the largest daily total

.07	.26	.17	.21	.15	.59	1.0

Sum these seven numbers and divide by 7

$\frac{2.44}{7}$ = .3497 monthly I.C.F.

PARK NAME: North Beach
MONTH: Aug

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
1977.5	1522.5	1123.5	406.0	843.5	1820.0	5299.0	1978
773.5	528.5	266.0	462.0	297.5	584.5	2380.0	1977
1466.5	836.5	1127.0	430.5	423.5	1708.0	2023.5	1976
4217.5	2887.5	2516.5	1298.5	1564.5	4112.5	4712.5	Total

Divide each daily total by the largest daily total

.43	.30	.26	.13	.16	.42	1.0

Sum these seven numbers and divide by 7

$\frac{2.7}{7}$ = .3857 monthly I.C.F.

PARK NAME: [illegible]
MONTH: May

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
241.4	20.4	—	23.8	1108.4	1689.8	2230.4	'76
957.	102.	57.	69.	213.	1194.0	3033.	'77
729.0	168.	153	60.	228	1122.	2724.	'78
1927.4	290.4	210.	152.8	1549.4	4005.8	7987.4	Total

Divide each daily total by the largest daily total

.24	.04	.03	.02	.19	.50	1.0

Sum these seven numbers and divide by 7

$\frac{2.02}{7}$ = .2886 monthly I.C.F.

PARK NAME: North Beach
MONTH: Sept.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
220.5	—	—	—	108.5	159.0	322.0	1978
477.0	123.0	—	—	129.0	—	141.0	1977
15.5	6.2	12.4	3.1	18.6	31.0	155.0	1976
713.0	129.2	12.4	3.1	256.1	290.0	618.0	Total

Divide each daily total by the largest daily total

1.0	.18	.01	.004	.36	.41	.87

Sum these seven numbers and divide by 7

$\frac{2.834}{7}$ = .4049 monthly I.C.F.

PARK NAME:
MONTH:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\quad}{7}$ = ____ monthly I.C.F.

PARK NAME:
MONTH:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
							Total

Divide each daily total by the largest daily total

Sum these seven numbers and divide by 7

$\frac{\quad}{7}$ = ____ monthly I.C.F.

P. [illegible]E: Outlet
MONTH: July

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
2366.4	2794.8	3304.8	3284.4	2696.2	4178.5	10886.8	'76
3132.	3628.8	4154.4	3366.	5349.6	9658.8	21132.	'77
4334.4	4086.	3315.6	3729.6	2980.8	10108.8	18860.4	'78
9832.8	10509.6	10774.8	10380.0	11026.6	23946.1	50879.2	Total

Divide each daily total by the largest daily total

.19	.21	.21	.20	.22	.47	1.0

Sum these seven numbers and divide by 7

$\frac{2.5}{7}$ = .3571 monthly I.C.F.

PARK NAME: Outlet
MONTH: Sept

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
873.	12.0	30.0	243	219.	276.	564.	'76
282	21.0	12.	420	186.	972.	1683.	'77
894.	12.0	42.	6.	372	1539	486.	'78
1449.	26.	84.	1263.	777.	2787.	2733.	Total

Divide each daily total by the largest daily total

.52	.01	.03	.45	.28	1.0	.98

Sum these seven numbers and divide by 7

$\frac{3.27}{7}$ = .4671 monthly I.C.F.

PARK NAME: Outlet
MONTH: June

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
679.0	609	749.	500.5	857.5	3962.	7885.5	'76
832.	892.8	694.4	1267.2	448.	1510.4	4774.4	'77
352.	1315.2	851.2	451.2	1152.	2185.6	7939.2	'78
1863.	2817.	2294.6	2218.9	2457.5	7658.	20599.1	Total

Divide each daily total by the largest daily total

.09	.14	.11	.11	.12	.37	1.0

Sum these seven numbers and divide by 7

$\frac{1.940}{7}$ = .2771 monthly I.C.F.

PARK NAME: Outlet
MONTH: Aug.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Year
3003.	2907.3	3864.3	2148.3	1795.2	4197.6	8662.5	'76
2325.	2095.6	1435.3	1860.	1847.6	2672.2	5462.2	'77
4326.3	3296.7	3045.9	1240.8	2603.7	5085.3	12936.	'78
9654.3	8299.6	8345.5	5249.1	6246.5	8455.1	27060.7	Total

Divide each daily total by the largest daily total

.36	.31	.31	.19	.23	.31	1.0

Sum these seven numbers and divide by 7

$\frac{2.71}{7}$ = .3871 monthly I.C.F.

Annex F - COMPATRAX Recreation/Tourism Participation Allocation Model Documentation

COMPATRAX RECREATION/TOURISM PARTICIPATION ALLOCATION MODEL DOCUMENTATION

1. Overall Description of the Model: The COMPATRAX recreation demand allocation model has been refined by Midwest Research Institute (MRI) in a series of recreation/tourism, market analyses, and strategic planning projects accomplished for governments, regional planning groups, and private investors. The fundamental concept of COMPATRAX is that demand originates with people rather than with sources and that the proper market analysis requires projection of people's demands and allocation of these demands among competitive resource concentrations.

The MRI COMPATRAX Recreation Participation/Allocation Model is computer-based and provides estimates of current and future usage at individual recreational destination complexes. The model's underlying rationale is as follows:

a. Recreational demands are generated by the recreational participation desires of individuals and are thus functions of numbers and characteristics of population groups;

b. The satisfaction of demand for recreational usage at any individual recreation destination complex, derived from each market concentration, depends on the distance the complex is from the market and the relative extent and quality of that complex's recreational resources compared with the extent and quality of resources at all other competitive destination complexes.

The COMPATRAX model permits the inclusion of a large number of destination complexes and market concentrations in the determination of usage at any individual destination complex.

a. "Primary market area" refers to the metropolitan and nonmetropolitan population concentrations expected to provide the market support for any recreation or tourism destination areas to be studied. For example, this might be the entire southern half of the United States. The primary market area is composed of a large number of "market centers." These are the smallest geographical units for which separate demographic data and projections are universally available; typically, they are SMSA's 1/

For the Lake Erie recreational beaches model, the "primary market area" was the four states surrounding the lower Great Lakes (Lakes Erie and Ontario), and the "market centers" were adjacent lake counties and SMSAs in the four states. Conceptually, the primary market area can be expanded or contracted to meet particular requirements. The important aspect is that the COMPATRAX model treats many separate market centers within the primary market area individually and does not require unrealistic aggregation of demand into national or regional totals.

b. The model treats total recreation and tourism market behavior as a function of specific "key outdoor recreation activities": attending outdoor

1/ Standard Metropolitan Statistical Area, as defined by the Bureau of the Census, U. S. Department of Commerce.

events, boating, camping, boating for pleasure, fishing, hiking, hunting, nature walking, sailing, sightseeing, snow skiing, swimming, water skiing, picnicking, horseback riding, etc. Although the Heritage Conservation and Recreation Service (formerly BOR) has identified a larger number of other outdoor recreation activities, they are not included in COMPATRAX analysis because they exert relatively little influence on the choice of destination, compared with that of the key activities. In any analysis, additional activities can be introduced if it is necessary to project specific requirements for particular facilities. 2/

c. The model is concerned with three classes of recreation destination areas:

(1) "Primary complexes" are those that are the focus of a study in question; in some uses of the model, there may be only one primary complex, while in other applications, there could be a very large number (such as 17 reaches along Lakes Erie and Ontario and the connecting waterways).

(2) "Competitive complexes" include those other recreation areas within the same broad region as the primary complexes that offer essentially the same types of climate, topography, resources, facilities, amenities, and activities as the primary complexes (in the Lake Erie recreational beaches model, the Statewide Comprehensive Outdoor Recreation Plan (SCORP) regions in the four states).

(3) "Competitive areas" include those other classes of recreation destinations that differ in one or more fundamental ways from both the primary and competitive complexes in terms of resources, climate, topography, facilities, amenities, activities, and, hence, market appeal.

d. The following are the major advantages of the COMPATRAX model:

(1) It is among the first programs in the field of recreation economics to be truly market-oriented rather than resource-oriented. Prior approaches, whether operated manually or by computer, tend to focus on one or more resource areas, drawing concentric circles around these resource areas to determine what markets might be incorporated at various distances. The COMPATRAX model, on the other hand, draws concentric circles around the market where the demand actually originates and allocates this demand among all of the competitors for this market in accordance with distance factors and the relative attractiveness of the individual complexes.

2/ For the Lake Erie recreational beaches model, only swimming in a natural environment was included in the analysis.

(2) It establishes a reasonable basis for eliminating from further consideration that portion of the demand that, for reasons of personal preference on the part of individual market segments, is not available to any given generalized class of attraction that may be under study.

(3) It treats the influence of the resource-market distance through utilization of empirically derived recreational behavior data, in contrast to many mathematical approaches that employ an arbitrary "gravity flow" approach that does not accurately represent actual behavior.

(4) It preserves, in segregated form, the breakdown of total recreational activity-days in each class of recreational activity into the occurrence categories of Few Available Hours, All-Day Outings, Overnight Trips, and Vacations, (or any other leisure behavior patterns) and, thus, can incorporate the obvious differences in the economy of a recreational complex. Aproaches that aggregate all categories of occurrence into a single total activity-day demand cannot make this discrimination and, consequently, cannot illustrate the differences in economic impacts on areas that are primarily day-use compared with those that are oriented toward overnight stays.

(5) It provides both a rationale and a technique for dealing with the extremely troublesome problem of double-counting in the process of arriving at expenditure data expressed in terms of activity-days rather than visitor-days.

(6) It provides a particularly valuable planning and marketing tool in its ability to determine the relative numerical importance of individual market areas as potential sources of visitors to any given complex.

e. The output of the COMPATRAX model is illustrated by the following six tables excerpted from the computer printouts of a model run for several destination complexes in New York State. All tables refer to the Cranberry Lake Complex in the Northwestern Adirondacks. The following should be noted for each of the six tables, respectively:

(1) Projections of participation in 13 individual key recreational activities (for this application) for 1970-1985, are expressed in thousands of activity-days.

(2) Projections of several visitor expenditure categories and total expenditures for a single future year, are expressed in thousands of dollars. "Few available hours" projections show a zero value since the local population base is too sparse to generate significant demands.

(3) Projections of visitor-days, or "people-days," for two future years, are expressed in thousands.

(4) Projections of total visitors to the complex for two future years, are expressed in thousands.

(5) Projections of visitor-nights, or "overnight-stays," for two future years, are expressed in thousands. "Camper" values are zero because campers do not occupy hotel/motel rooms. "All-day outing" values are zero because, by definition, this occurrence category does not involve any overnight stay.

(6) The market summary shows the sources of visitors to the complex in rank order, with the number of visitors in each of 4 years, the percentage of total visitors originating in each market center, and a cumulative percentage of total visitors.

2. COMPATRAX II Model Logic: The COMPATRAX II model evolved from the original COMPATRAX model and MAVEN I, developed in a study for the Orange County, California Environmental Management Agency. 1/ In that study, MRI was a subcontractor to PBQ and D, Inc., of Santa Ana, California. Since MAVEN I was installed on California computer equipment, MRI prepared a handbook for users. It provides documentation for both the recreation planner and computer analyst. This handbook, along with the computer program and documentation provided in Technical Report No. 8, provides the program logic of COMPATRAX II and is on file at the Buffalo District, Corps of Engineers.

a. Model flow and Lake Erie data: The following section provides a description of the model flow and data used in the Lake Erie study of recreational beaches:

(1) Source of Data: The State Comprehensive Outdoor Recreation Plans (SCORP) of the four border states (New York, Pennsylvania, Ohio, and Michigan) provided the basic source of data for projecting swimming use in the future for U.S. shoreline beaches. All except Ohio have conducted a recent recreation survey and have provided per capita use rates for swimming in natural environments on an annual basis ("n" times per year). Since a comparable rate was not available for the State of Ohio, a recent nationwide study was used as the basic source of data (Midwest Research Institute's "Opportunities in the Leisure Industry Study"). A "no growth" assumption was made regarding swimming in natural environments (per capita rates were held constant).

1/ Recreation User Documentation for the MAVEN Participation Allocation Model (prepared by MRI under subcontract to PBQ and D, Inc.) for Orange County Environmental Management Agency, 29 March 1979.

Table 1 - Projected Demand Analysis
Total Market, Present Attractiveness Indices

Cranberry Lake Complex

Participation, Thousands of Activity Days, Percent of Total

	1970		1975		1980		1985	
Outdoor Events	8	.70	10	.74	12	.78	14	.81
Boating	67	5.76	78	5.88	92	6.12	109	6.37
Camping	29	2.52	35	2.62	41	2.76	49	2.87
Drive for Pleasure	205	17.67	203	15.28	201	13.43	197	11.56
Fishing	266	22.87	301	22.72	346	23.05	399	23.39
Hiking	17	1.51	20	1.51	23	1.55	27	1.60
Hunting	105	9.06	118	8.91	134	8.94	152	8.91
Nature Walking	101	8.72	115	8.68	131	8.76	150	8.80
Sailing	14	1.21	20	1.50	26	1.75	34	1.96
Sightseeing	143	12.36	176	13.29	187	12.46	227	13.30
Snow Skiing	17	1.43	20	1.54	25	1.65	29	1.72
Swimming	175	15.08	214	16.15	262	17.47	296	17.34
Water Skiing	13	1.11	16	1.18	19	1.28	23	1.37
Total	1,160	100.00	1,326	100.00	1,499	100.00	1,706	100.00

Table 2 - Projected Expenditure Analysis
Total Market, Present Attractiveness Indices

Cranberry Lake Complex

1980 Expenditures by Selected Types of Recreation Activity in Thousands of Dollars

	Few Available Hours	All Day Outing	Overnight Non-Campers	Overnight Campers	Vacation Non-Campers	Vacation Campers
General Activities						
Food	0	78	182	30	1,489	249
Lodging	0	0	182	8	1,489	61
Other	0	77	122	41	736	245
Total	0	154	487	79	3,715	555
Fishing						
Food	0	7	142	8	788	44
Lodging	0	0	142	2	788	11
Other	0	34	145	16	593	66
Total	0	42	429	26	2,170	121
Hunting						
Food	0	1	68	4	297	17
Lodging	0	0	68	1	297	4
Other	0	7	77	9	250	28
Total	0	8	212	13	844	48
Snow Skiing						
Food	0	1	24	0	89	0
Lodging	0	0	24	0	89	0
Other	0	3	66	0	185	0
Total	0	5	115	0	363	0
All Activities						
Food	0	88	416	42	2,664	309
Lodging	0	0	416	10	2,664	76
Other	0	121	409	65	1,764	339
Total	0	209	1,242	118	7,091	724

Table 3 - Projected Visitation Analysis
Total Market, Present Attractiveness Indices

Cranberry Lake Complex

	1980 Participation, Thousands of People Days					
	Few Available Hours	All Day Outing	Overnight		Vacation	
			Non-Campers	Campers	Non-Campers	Campers
General Activities	0	26	41	14	245	82
Fishing	0	8	32	4	130	14
Hunting	0	1	15	2	49	5
Snow Skiing	0	1	6	0	18	0
All Activities	0	35	94	19	442	102

	1985 Participation, Thousands of People Days					
	Few Available Hours	All Day Outing	Overnight		Vacation	
			Non-Campers	Campers	Non-Campers	Campers
General Activities	0	29	47	16	288	96
Fishing	0	8	36	4	150	17
Hunting	0	2	17	2	56	6
Snow Skiing	0	1	7	0	21	0
All Activities	0	40	107	21	514	119

Table 4 - Projected Visitation Analysis
Total Market, Present Attractiveness Indices

Cranberry Lake Complex

1980 Visitors, Thousands of People						
	Few Available Hours	All Day Outing	Overnight		Vacation	
			Non-Campers	Campers	Non-Campers	Campers
General Activities	0	26	15	5	23	8
Fishing	0	8	12	1	12	1
Hunting	0	1	6	1	5	1
Snow Skiing	0	1	4	0	2	0
All Activities	0	35	35	7	42	10

1985 Visitors, Thousands of People						
	Few Available Hours	All Day Outing	Overnight		Vacation	
			Non-Campers	Campers	Non-Campers	Campers
General Activities	0	29	17	6	27	9
Fishing	0	8	13	1	14	2
Hunting	0	2	6	1	5	1
Snow Skiing	0	1	4	0	2	0
All Activities	0	40	40	8	48	11

Table 5 - Projected Visitation Analysis
Total Market, Present Attractiveness Indices

Cranberry Lake Complex

1970 Overnight Stays, Thousands of People Days						
	Few Available Hours	All Day Outing	Overnight		Vacation	
			Non-Campers	Campers	Non-Campers	Campers
General Activities	0	0	21	0	176	0
Fishing	0	0	18	0	99	0
Hunting	0	0	9	0	38	0
Snow Skiing	0	0	3	0	12	0
All Activities	0	0	52	0	325	0

1975 Overnight Stays, Thousands of People Days						
	Few Available Hours	All Day Outing	Overnight		Vacation	
			Non-Campers	Campers	Non-Campers	Campers
General Activities	0	0	26	0	212	0
Fishing	0	0	21	0	113	0
Hunting	0	0	10	0	43	0
Snow Skiing	0	0	4	0	15	0
All Activities	0	0	60	0	382	0

Table 6 - Market Summary
Total Market, Present Attractiveness Indices

Ranking of Top 50 Projected Demand Sources for
Cranberry Lake Complex

Note - Columns for Each Year Contain
Col. 1 - Thousands of Visitors
Col. 2 - Percent of all SMSA Demand
Col. 3 - Comulative Percent

Line	ID	Name	State	1970			1975			1980			1985		
					0/0	Cum. 0/0		0/0	Cum. 0/0		0/0	Cum. 0/0		0/0	Cum. 0/0
1	45	Syracuse	NYK	19.4	20.6	20.6	22.5	20.4	20.4	25.9	20.3	20.3	29.6	20.1	20.1
2	40	Albany-Schen.-Troy	NYK	13.2	14.0	34.5	15.3	13.9	34.3	17.6	13.8	34.1	20.1	13.6	33.7
3	51	New York-N.E.N.J.	NJY	3.7	3.9	38.4	4.4	4.0	38.2	5.3	4.1	38.2	6.3	4.3	38.0
4	187	Vt. Non-Metropolitan	VER	3.4	3.6	42.0	3.9	3.6	41.8	4.7	3.6	41.9	5.5	3.8	41.8
5	61	Philadelphia	PEN	2.8	2.9	44.9	3.3	3.0	44.8	3.9	3.1	44.9	4.7	3.2	45.0
6	204	Queens County - New York	NWK	1.7	1.8	46.8	2.1	1.9	46.7	2.3	1.8	46.8	2.5	1.7	46.7
7	11	Boston	MAS	1.7	1.8	48.6	2.0	1.8	48.5	2.3	1.8	48.6	2.7	1.9	48.6
8	155	N.C. Non-Metropolitan	NCA	1.7	1.8	50.4	1.9	1.7	50.2	2.1	1.7	50.3	2.4	1.6	50.2
9	206	Nassau County - New York	NWK	1.6	1.7	52.1	1.9	1.7	52.0	2.1	1.6	51.9	2.2	1.5	51.7
10	202	Kings County - New York	NWK	1.5	1.6	53.7	1.9	1.7	53.7	2.0	1.6	53.4	2.2	1.5	53.2
11	211	Oneida County	NWK	1.4	1.5	55.2	1.6	1.4	55.1	1.8	1.4	54.8	1.9	1.3	54.5
12	70	Pa. Non-Metropolitan	PEN	1.4	1.5	56.7	1.4	1.2	56.4	1.4	1.1	55.9	1.5	1.0	55.5
13	217	Utica, New York	NWK	1.3	1.4	58.0	1.4	1.3	57.7	1.6	1.2	57.2	1.7	1.2	56.7
14	75	Baltimore	MAR	1.3	1.3	59.4	1.5	1.4	59.0	1.8	1.4	58.6	2.1	1.4	58.1
15	44	Rochester	NYK	1.3	1.3	60.7	1.5	1.3	60.3	1.7	1.3	59.9	2.0	1.4	59.5
16	42	Buffalo	NYK	1.2	1.2	61.9	1.4	1.2	61.6	1.6	1.2	61.1	1.8	1.2	60.7
17	64	Pittsburgh	PEN	1.0	1.0	63.0	1.2	1.0	62.6	1.4	1.1	62.2	1.6	1.1	61.8
18	208	Suffolk County - New York	NWK	.9	1.0	64.0	1.2	1.1	63.7	1.2	1.0	63.2	1.4	.9	62.7
19	131	Va. Non-Metropolitan	VIR	.9	1.0	65.0	1.1	1.0	64.7	1.3	1.0	64.2	1.5	1.0	63.7
20	170	Ga. Non-Metropolitan	GEA	.9	1.0	65.9	1.0	.9	65.6	1.1	.9	65.1	1.3	.9	64.6
21	210	Herkimer County	NWK	.9	.9	66.8	1.0	.9	66.5	1.1	.8	65.9	1.2	.8	65.4
22	140	Ky. Non-Metropolitan	KTY	.8	.9	67.7	.9	.8	67.3	1.0	.8	66.7	1.1	.8	66.2
23	146	Tenn. Non-Metropolitan	TEN	.8	.8	68.6	.9	.8	68.1	1.0	.8	67.5	1.0	.7	66.9
24	55	Non-Metropolitan	NJY	.8	.8	69.4	1.0	.9	69.0	1.2	.9	68.4	1.5	1.0	67.9
25	182	Miss. Non-Metropolitan	MIS	.7	.8	70.1	.8	.8	69.7	1.0	.8	69.2	1.1	.8	68.7
26	41	Binghamton	NYK	.7	.8	70.9	.8	.7	70.5	.9	.7	69.9	1.0	.7	69.4
27	99	Ohio Non-Metropolitan	OHO	.7	.8	71.7	.8	.7	71.2	.9	.7	70.5	1.0	.7	70.1
28	201	Bronx County - New York	NWK	.7	.8	72.4	.9	.8	72.0	.9	.7	71.3	1.0	.7	70.8
29	80	Cleveland	OHO	.7	.7	73.2	.8	.7	72.7	1.0	.8	72.0	1.2	.8	71.6
30	161	S.C. Non-Metropolitan	SCA	.6	.7	73.8	.7	.7	73.4	.8	.7	72.7	1.0	.7	72.3
31	115	Detroit	MIC	.6	.7	74.5	.8	.7	74.1	.9	.7	73.4	1.1	.7	73.0
32	179	Ala. Non-Metropolitan	ALA	.6	.7	75.2	.7	.6	74.7	.8	.6	74.0	.9	.6	73.6
33	213	Rome, New York	NWK	.6	.7	75.9	.7	.6	75.3	.8	.6	74.6	.9	.6	74.2
34	53	Philadelphia	PEN	.6	.6	76.5	.7	.7	76.0	.9	.7	75.3	1.0	.7	74.9
35	283	New York County - New York	NWK	.6	.6	77.1	.7	.6	76.6	.8	.6	75.9	.8	.6	75.5

The basic supply information in the COMPATRAX analysis was the linear feet of available beach in supply regions. All four states provided an estimate of the linear feet of beach available for SCORP regions. The U.S. inventory of beaches on Lakes Erie and Ontario provided an estimate of the linear feet of beach in each of the reaches. No attempt was made to rate the quality of any of the beaches. In other words, each foot of beach in an area is considered of equal quality to a similar measure of beach in every other region.

Approximately 80 demand origins and 70 supply destinations were input into the model; and utilizing observed travel characteristics (when people participate in recreation, how far they travel, etc.), forecasts of the annual swimming occasions occurring in natural environments were projected for each of the 17 U.S. reaches for 1985, 1995, 2005, and 2015.

(2) Demand: The COMPATRAX model utilizes annual per capita recreation rates for unique populations and multiplies these rates by forecast population. The per capita rates for the four states included in the American forecasts are:

State	Annual Per Capita Occasions of Swimming in Natural Environments
Michigan	4.71
New York	4.38
Ohio	4.82
	(northeast Census Region)
Pennsylvania	4.64

The population forecasts were provided by the Census Bureau's latest "Series E" national population and projection and the Bureau of Economic Analysis' industrial and regional disaggregation thereof as published in the 1972-E OBERS Projections, November 1974. The supply regions (SMSAs and adjacent lake counties) are listed in the COMPATRAX output in MRI's Technical Report No. 8.

All demand areas are located by the model utilizing longitude and latitude coordinates. These spatial relationships provide a distance relationship between other demand areas and the recreation destinations (the supply). For each of the demand areas, the forecast population for a given year is multiplied by the estimated per capita recreation activity occasions (in this case, annual swimming occasions in a natural environment). The next step in the model is to allocate this potential demand (actually consumption of recreation) into the various periods of time that people might take part in the activity. The various leisure activity periods for the model are

listed below along with the percentage of recreation demand that is allocated into each of the periods:

Leisure Activity Period (Swimming in Natural Environments)	Percent
Few Available Hours	9
All-Day Outings	39
Overnight Trips	15
Vacations	37

After the potential demand for a given origin area is segregated into the periods of time that the activity occurs, the next step is to segregate the amount of activity in each one of these activity periods into the distance band that people might travel to take part in the activity. In other words, this provides the basis and power for the allocation. For example, people participating in few available hours (after work, etc.) are much less likely to travel beyond 50 miles than those participating in swimming in natural environments on vacations. The distance bands and the percent of swimming activity that takes place within each one of these bands by leisure activity period are provided below:

One-Way Road Distance Between Origin and Destination (miles)	Percent			
	Vacation	Overnight Trips	All-Day Outings	Few Available Hours
0- 25	0	14	19	65
26- 50	5	16	19	19
51- 75	8	22	23	11
76-175	20	33	39	5
176-275	16	8	0	0
276-475	20	6	0	0
Over 475	31	1	0	0

The basic data utilized to separate swimming activity into leisure activity periods have been provided by a variety of U.S. research studies as well as in-house studies conducted by Midwest Research Institute. Data used in the distance/distribution matrix were originally derived from data contained in the 1965 BOR recreation demand study. These have been updated in subsequent SCORP efforts and other recent studies.

In summary, each demand area in the model is located spatially. Annual per capita activity occasions are multiplied by population forecasts to produce potential demand. This demand is separated into the periods of time that people normally participate in recreation, and it is then allocated into the distance zones specified above. The origin areas for the Lake Erie recreation beach analysis included two to three counties inland from all lakes and water ways in the four states, as well as all of the remaining SMSAs in the four states. Non-SMSA population in the remainder of the states was proportioned into the counties and SMSAs based on their relative sizes.

(3) Supply: As with the demand areas, supply areas are first located by longitudinal and latitudinal coordinates. This provides a relative location to other supply areas as well as the demand origins. In the Lake Erie model, the supply areas include all of the SCORP supply regions in the four states as well as the 17 reaches along Lakes Erie and Ontario and the connecting waterways. The supply regions and the existing resource units (linear feet of beach) are listed in the COMPATRAX output in MRI's Technical Report No. 8. 1/

(4) Allocation: The allocation of recreational activity participation to supply resources is the final phase and most crucial step in the COMPATRAX II model. All prior steps, including the demand functions discussed above, are designed to prepare the raw demand and supply data for this allocation step. Bands corresponding to the distances in the distance/distribution matrix are first mathematically computed around each demand generator. It should be remembered that geographical coordinates establish the distance relationship between origin and destination areas.

After the potential demand is estimated for an origin area and apportioned into the leisure activity participation periods and distance zones, the model searches (by demand origin) for available supply regions within each one of the activity periods and distance zones. The model then allocates the potential demand to the appropriate supply area based on the relative quantity (and quality, if available) of resources within the particular zone. An example of the allocation process is provided in Illustration No. 1.

1/ It should be noted that linear feet of beach is used as a factor in allocating swimming participation in the COMPATRAX model. Although square feet of beach was calculated by the Lake Erie regulation model (see MRI's Final Report--both demand and supply equations), a corresponding measure for computing areas was not available for input into the COMPATRAX model. While MRI's field inventory provided the square feet at each beach along Lakes Erie and Ontario and the connecting waterways, similar data for non-Great Lakes beaches are not provided in the State Comprehensive Outdoor Recreation Plans (Michigan, Ohio, Pennsylvania, and New York). The state plans present supply data for swimming only, in terms of linear feet of beach. Since comparability of data bases is essential for use in the COMPATRAX model, MRI simply utilized the lineal feet of beach available by reach from the field inventory and subtracted this from the total supply of linear feet available for each of the corresponding SCORP regions adjacent to the lake reaches. Thus, MRI did not double count the supply of beaches in the vicinity of lakes. Since similar measures were used, and fluctuating lake levels do not result in expanding area of beach to any great extent, it is felt that the use of linear feet (as an allocation factor) will not have a major impact on the total benefits provided by the various lake level regulation plans.

ILLUSTRATION NUMBER 1
EXAMPLE OF ALLOCATION

Demand (Hypothetical)

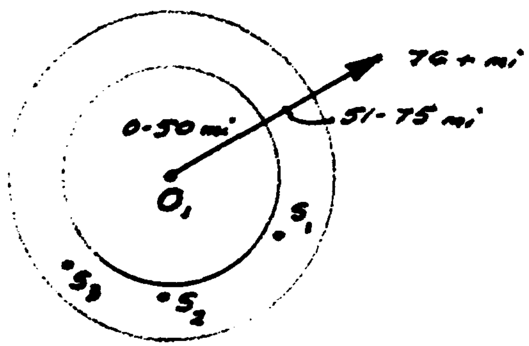
Origin Area with 10,000 people
4.5 per capita occasions of recreation activity
Allocation:
- . Overnight leisure period (15% of recreation activity)
- . 51-75 mile distance band (22% of overnight leisure activity)

Supply (Hypothetical)

Recreation system with 3 destinations in a distance zone.
- . S_1 - 500 supply units (50%)
- . S_2 - 300 supply units (30%)
- . S_3 - 200 supply units (20%)

ALLOCATION

Graphical



Numerical

1. 10,000 population x 4.5 = 45,000 recreation occasions.
2. 0.15 x 45,000 = 6,750 recreation occasions on overnight trips.
3. 0.22 x 6,750 = 1,485 overnight recreation occasions in 51-75 distance zone.
4. S_1 - 0.5 x 1,485 = 742[a]
5. S_2 - 0.3 x 1,485 = 446
6. S_3 - 0.2 x 1,485 = 297

1,485

a S_1 (area of interest - model sums activity periods and distance zones of all origin areas for S_1).

For the Lake Erie analysis, a total of 80 demand origins and 70 supply destinations were input into the COMPATRAX model. It should be recognized that the fewer the demand/supply areas, the greater the chance that some demand will be lost within the system. For example, as the computer searches for available supply units in particular distance zones, if a supply region is not found, then that demand vanishes. In reality, people simply travel further to the next supply region (a beach) to participate in swimming or whatever the activity might be. In the model, however, this demand (or participation) simply vanishes. This is commonly referred to as the "aggregation problem." As more supply/demand input points are designated, more demand shows up in the total system. Since the model, as a whole, is based on average use, supply characteristics, participation patterns, etc., the aggregation problem should not have a major impact on the accuracy of the forecasts as a whole. If anything, the total activity days of swimming, forecast by the model, is underestimated.

b. Visitation Forecasts: The activity forecasts for 1985 through 2015 are shown on a following page. The Lake Erie Regulation evaluation requires an analysis of demand up through 2035. Thus, a straight-line projection of COMPATRAX activity was made for 2025 and 2035. The demand for these latter 2 years is contained in MRI's Final Report to the Buffalo District.

c. COMPATRAX Travel Values: A major output of the model is the market summary (the top 30 market areas in terms of the number of visitors, percent of use, and cumulative percent). The market summary for R008 follows the activity analysis summary. These outputs were used to compute the COMPATRAX travel values as shown in Illustration No. 2.

Table 7 - Activity Analysis - Summary Over All Attractions
(Participation and Percent of Total)

	1985		1995		2005		2015	
	Activity Days (Thousands)							
St. Lawrence River Reach R008	105	.39	112	.38	120	.38	126	.37
St. Lawrence River Reach R007	0	0.00	0	0.00	0	0.00	0	0.00
St. Lawrence River Reach R006	69	.26	78	.25	80	.25	85	.25
Lake Ontario Reach R2005	61	.23	67	.23	73	.23	77	.23
Lake Ontario Reach R2004	541	2.02	572	1.96	608	1.91	630	1.86
Lake Ontario Reach R2003	739	2.77	870	2.97	1,017	3.19	1,085	3.21
Lake Ontario Reach R2002	768	2.88	906	3.10	1,059	3.32	1,117	3.31
Lake Ontario Reach R2001	419	1.57	476	1.63	540	1.70	568	1.68
Niagara River Reach R005	0	0.00	0	0.00	0	0.00	0	0.00
Niagara River Reach R004	1,110	4.16	1,174	4.01	1,259	3.95	1,296	3.84
Lake Erie Reach R3004	5,675	21.25	6,097	20.84	6,572	20.63	6,903	20.43
Lake Erie Reach R3003	6,859	25.68	7,423	25.37	8,006	25.13	8,480	25.09
Lake Erie Reach R3002	4,191	15.69	4,649	15.89	5,093	15.98	5,469	16.19
Lake Erie Reach R3001	1,086	4.07	1,214	4.15	1,342	4.21	1,446	4.28
Detroit River Reach R003	1,514	5.67	1,674	5.72	1,813	5.69	1,936	5.73
Lake St. Clair Reach R002	3,570	13.37	3,950	13.50	4,281	13.44	4,574	13.54
St. Clair River Reach R001	0	0.00	0	0.00	0	0.00	0	0.00
Total	26,707	100.00	29,262	100.00	31,863	100.00	33,793	100.00

COMPATRAX II Recreation Model
Midwest Research Institute
Kansas City, Missouri

Buffalo District
Corps of Engineers
Beaches Activity Analysis

Table 8 - Market Analysis
Activity Days (Thousands)
Demand, Percent of Total and Cumulative Percent

St. Lawrence River Reach R008

	Demand Area Name	1985 Demand	1985 Pct.	1985 Cum.	1995 Demand	1995 Pct.	1995 Cum.	2005 Demand	2005 Pct.	2005 Cum.	2015 Demand	2015 Pct.	2015 Cum.
1	New York, St. Lawrence County	90.6	86.1	86.1	96.0	85.6	85.6	102.0	85.1	85.1	107.7	85.1	85.1
2	New York, Syracuse SMSA	3.5	3.3	89.4	3.8	3.4	89.0	4.2	3.5	88.6	4.2	3.4	88.5
3	New York, Albany-Schenectady-Troy S	3.2	3.0	92.4	3.6	3.2	92.2	4.1	3.4	92.0	4.6	3.6	92.1
4	New York, Utica-Rome SMSA	1.9	1.8	94.2	2.0	1.7	94.0	2.0	1.7	93.7	2.0	1.6	93.7
5	New York, Rochester SMSA	1.8	1.7	95.9	2.2	1.9	95.9	2.6	2.2	95.9	2.7	2.2	95.9
6	New York, Buffalo SMSA	1.1	1.1	97.0	1.2	1.1	96.9	1.3	1.1	96.9	1.3	1.0	96.9
7	Pennsylvania, Warren County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
8	Pennsylvania, Venango County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
9	Pennsylvania, Crawford County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
10	Pennsylvania, Mercer County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
11	Pennsylvania, Erie SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
12	Pennsylvania, Allentown-Bethlehem-E	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
13	Pennsylvania, Altoona SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
14	Pennsylvania, Harrisburg SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
15	Pennsylvania, Johnstown SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
16	Pennsylvania, Lancaster SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
17	Pennsylvania, Philadelphia SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
18	Pennsylvania, Pittsburgh SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
19	Pennsylvania, Reading SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
20	Pennsylvania, Wilkes-Barre SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
21	Pennsylvania, York SMSA	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
22	Ohio, Fulton County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
23	Ohio, Henry County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
24	Ohio, Hancock County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
25	Ohio, Ottawa County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
26	Ohio, Sandusky County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
27	Ohio, Seneca County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
28	Ohio, Wyandot County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
29	Ohio, Crawford County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
30	Ohio, Erie County	0.0	0.0	97.0	0.0	0.0	96.9	0.0	0.0	96.9	0.0	0.0	96.9
	Sum	101.9	97.0	97.0	108.6	96.9	96.9	116.1	96.9	96.9	122.6	96.9	96.9
	Total	105.0	100.0	100.0	112.1	100.0	100.0	119.8	100.0	100.0	126.5	100.0	100.0

ILLUSTRATION NUMBER 2

COMPATRAX TRAVEL VALUES (R008)--
See Attached Market Analysis

Origin Area	No. of Visitors	One-Way Distance (Air Miles x 1.35)	$/Mile[a] (round trip) x Distance x No. of Visitors
1	90.4	45	$1,302
2	3.5	194	217
3	3.2	223	228
4	1.9	173	105
5	1.8	241	139
6	1.1	324	114
Total	101.9		$2,105

COMPATRAX Travel Values (per individual) $= \dfrac{\text{Total Travel Costs}}{\text{Total No. of Visitors}} = \dfrac{\$2,105}{101.9} = \dfrac{\$20.66/\text{Person}}{3.7\ \text{Persons/car}} = \$5.58\ +$

Entrance Fee (69¢)[b] = $6.27

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[a] 16¢/mile x 2 (round trip)

[b] MRI recreation beach supply inventory

The average distance traveled by beach swimmers and the COMPATRAX travel values by reach are listed below:

Reach	Average One-Way Distance (Top 10)	Average One-Way Distance (All Visitor Sources)	COMPATRAX Travel Values (All Visitor Sources)
			$
R008	65	65	6.27
R007	-	-	-
R006	105	105	9.77
2005	83	83	7.90
2004	94	97	9.09
2003	66	74	7.08
2002	52	59	5.77
2001	104	115	10.61
R005	-	-	-
R004	27	30	3.26
3004	156	165	14.91
3003	152	154	14.02
3002	110	95	10.48
3001	36	44	4.52
R003	20	25	2.88
R002	25	30	3.29
R001	-	-	-
Average Weighted Value	100	105	10.12

Addendum to COMPATRAX Travel Values

Upon review of the input variables used in the COMPATRAX model, it was observed that "double counting" occurred for a proportion of value associated with projected beach visitation. This portion includes values of overnight and vacation trips where more than one opportunity is consumed per person per trip. In other words, in the initial calculation, the average weighted value per trip was used instead of average weighted value per opportunity. Adjustment factors were then developed to correct this oversight.

It was noted that the market summaries of the COMPATRAX activity-day output were utilized to develop the travel values. Essentially, these market summaries show the number of activity days originating in major market centers and "rank order" list these sources by origin area. In using these market summaries, the assumption is that a visitor travels the entire distance from origin "n" to destination "n" each time he participates in an activity (in this case, swimming). However, some visitors may camp or stay in a motel near the beach for several days to more than a week and swim each day he visits the beach. Thus, his distance from origin "n" to destination "n" actually takes place only once, with a short commuting distance between the hotel or campground taking place daily. The use of the activity-day market summaries tends to overestimate the total mileage involved in travel, and thus overestimates the travel cost per person.

Although the COMPATRAX model provides market summaries by visitor-day, visitors, and visitor-nights, this option was not utilized; thus, they are not available in Technical Report No. 8. Because of the timing involved, rather than rerunning the model, MRI developed correction factors for use in estimating the number of visitors coming from each origin area. The calculation of the adjustment factor is shown on the attached tables. Essentially, all few available hours and all-day outing trips are multiplied by 1 (given full value). The remaining number of trips (overnight and vacation trips) are multiplied by the factor 0.54 (roughly half their value). (Table 9) This is the factor currently utilized in the COMPATRAX model for estimating the number of visitors. The adjustment factors are higher for origin areas close to destination areas than they are for more distant origins. In other words, more of the trips from these areas tend to be round trips incurring on the day the activity takes place. Whereas, the more distant origin areas are corrected downward to account for the number of people staying in overnight accommodations. The adjustment factors were then applied to the activity-day outputs as shown in Table 10. Finally, the average one-way travel distances (top 10 visitor sources) and the per capita travel costs are shown for each of the reaches in the study area in Table 11.

Table 9 - Development of the Adjustment Factors

Distance (bands)	Coefficients from the COMPATRAX Model: Vacation (percent)	Overnight (percent)	Total Vacation and Overnight	Adjustment Factor
0-25	0	14.3[a]	14.3	0.934[b]
26-50	8.5	27.1	35.6	0.836
51-75	12.5	34.4	46.9	0.784
76-175	20.6	34.4	55.0	0.749
176-275	66.6	33.3	100.0	0.540
276-475	76.9	23.1	100.0	0.540
Over 475	96.9	3.1	100.0	0.540

a Percent of activity, 0-25 mile zone

Vacation (vac)	0%	
Overnight Trips (ON)	14%	Overnight
All-Day Outings (ADO)	19%	Factor = 14/98 X 100 = 14.3
Few Available Hours (FAW)	65%	
	98%	

b Example (origin with 10,000 visits)

10,000

FAW + ADO (85.7%) - 8,570 X 1.00 = 8,570

$$\text{ON + vac } \frac{(14.3\%)}{100.0} - \frac{1,430}{10,000} \times 0.54 = \frac{\dfrac{772}{9,342}}{10,000} = 0.934$$

Table 10 - Use of Adjustment Factors
(Illustration No. 2 - R008)

Origin Area	Miles	Adjustment Factor	\$/Mile (round trip) X Distance X No. of Visitors (see Illustration 2)	Adjusted Value
1	45	0.836	1,302	1,088[a]
2	194	0.540	217	117
3	223	0.540	228	123
4	173	0.749	105	79
5	241	0.540	139	75
6	324	0.540	114	62
Total				1,544

$$\text{COMPATRAX Travel Values/Individual (adjusted)} = \frac{\text{Total Travel Costs}}{\text{Total No. of Visitors}} = \frac{1{,}544}{101.9} = \frac{\$15.15/\text{person}}{3.7\ \text{persons/car}} = \$4.09 + 0.68 = \underline{\$4.77}$$

$$\text{Average One-Way Distance (miles) (adjusted)} = \frac{1{,}544}{0.32\ \text{(round trip cost/mile)}} = \frac{4{,}825\ \text{total miles traveled}}{101.9\ \text{total No. of visitors}} = \underline{47.35}\ \text{miles}$$

a \$1,302 X 0.836 (adjustment factor)

Table 11 - Adjusted COMPATRAX Distance and Travel Costs

	Avg. One-Way Distance (Top 10) (Miles)	Per Capita TC ($)
R008	47.3	4.77
R007	-	-
R006	72.8	6.98
2005	58.0	5.69
2004	63.8	6.20
2003	46.0	4.66
2002	37.4	3.91
2001	70.5	6.78
R005	-	-
R004	20.8	2.48
3004	98.8	9.23
3003	94.0	8.81
3002	80.9	7.67
3001	29.7	3.25
R003	14.9	1.97
R002	19.6	2.38
R001	-	-
Weight Average Entire Study Area	66.1	6.40

Annex G - Origin of Users

Table 1 - Wheatley - Origin of Users

Origin by County, District or Regional Municipality	Percent of Users	One-Way Distance On Map (cm)	One-Way Distance Actual (cm)	One-Way Distance Weighted (km)
Essex	53.9	4.9	39.2	2,112.9
Kent	19.4	7.1	56.8	1,101.9
Lambton	2.9	16.9	135.2	392.1
Huron	1.1	28.5	228.0	250.8
Middlesex	.3	18.9	151.2	45.4
Wentworth	.4	33.0	264.0	105.6
Ottawa Carleton	1.1	88.1	704.8	775.3
Ohio	5.0	8.0	64.0	320.0
Michigan	8.5	8.0	64.0	544.0
	92.6	213.40	1,707.2	5,648.0

Average weighted one-way distance 5,648.0 ÷ 92.6 = 60.99 km.

Average weighted round-trip distance = 121.98 km.

Table 2 - Long Point Park - Origin of Users

Map Scale: 1 cm = 8 km

Origin by County, District or Regional Municipality	Percent of Users	One-Way Distance		
		On Map (cm)	Actual (cm)	Weighted (km)
Essex	.4	31.1	248.8	99.52
Kent	.3	22.0	176.0	52.8
Middlesex	9.4	14.0	112.0	1,052.8
Elgin	6.4	10.2	81.6	522.24
Norfolk	7.6	10.1	80.8	614.08
Oxford	16.1	9.0	72.0	1,159.2
Perth	.5	17.9	143.2	71.6
Wellington	1.1	22.2	177.6	195.36
Waterloo	5.4	15.5	124.0	669.6
Brant	11.1	10.5	85.0	832.4
Haldimand	1.1	7.9	63.2	69.52
Niagara	2.1	17.0	136.0	285.6
Wentworth	17.7	15.2	121.6	2,152.32
Halton	3.5	17.3	138.4	484.4
Peel	1.2	23.0	184.0	220.8
Simcoe	.1	31.5	252.0	25.2
Metro Toronto	5.3	23.0	184.0	975.2
Durban	.3	31.0	248.0	74.4
Victoria	.1	39.9	319.2	31.92
Haliburton	.4	47.2	377.6	151.04
Prince Edward	.2	43.3	346.4	69.28
Ottawa Carlton	.2	62.5	500.0	100.0
Russell	2.5	76.3	610.4	244.16
Timiskaming	.1	69.0	552.0	55.2
Thunder Bay	.2	121.4	971.2	194.24
Quebec	.3	77.0	616.0	184.8
	93.6		6,920.6	10,587.68
Ohio	.3		4.6 - Other Canada, USA, world unspecified	
New York	1.3			
Michigan	.2			
	95.4			

Average weighted one-way distance = 10,587.68 ÷ 93.6 = 113.12 km.

Average weighted round-trip distance = 226.24 km.

Table 3 - Darlington - Origin of Users

Map Scale: 1 cm = 8 km

Origin by County, District or Regional Municipality	Percent of Users	One-Way Distance On Map (cm)	Actual (cm)	Weighted (km)
Essex	.4	48.1	384.8	153.92
Kent	.1	41.2	329.6	32.96
Lambton	.5	40.2	321.6	160.8
Middlesex	1.0	31.3	250.4	250.4
Norfolk	.1	23.0	184.0	18.4
Oxford	.1	23.2	185.6	18.56
Waterloo	.7	19.1	152.8	106.96
Niagara	.3	21.2	169.6	50.88
Wentworth	1.7	15.0	120.0	204.0
Peel	2.0	11.5	92.0	184.0
Simcoe	.3	17.3	138.4	41.52
York	.7	9.9	79.2	55.44
Metro Toronto	43.9	7.0	56.0	2,458.4
Durham	33.3	5.2	41.6	1,385.28
Victoria	.4	10.0	80.0	32.0
Haliburton	1.2	19.0	152.0	182.4
Northumberland	.3	8.9	71.2	21.36
Hastings	.5	20.1	160.8	80.04
Russell	.2	49.0	392.0	78.4
Quebec	2.3	48.4	387.2	890.56
	90.0		3,748.8	6,406.28
Illinois	.4			
Ohio	.7		7.2 - Other Canada, USA, world unspecified	
New York	1.1			
Michigan	.6			
	92.8			

Average weighted one-way distance = 6,406.28 ÷ 90.0 = 71.18 km.

Average weighted round-trip distance = 142.36 km.

Table 4 - Presquile - Origin of Users

Map Scale: 1 cm = 8 km

Origin by County, District or Regional Municipality	Percent of Users	One-Way Distance On Map (cm)	Actual (cm)	Weighted (km)
Kent	.4	53.8	430.4	172.16
Elgin	.1	42.0	336.0	33.6
Waterloo	.6	25.1	200.8	120.48
Brant	.4	30.1	240.8	96.32
Niagara	1.6	29.0	232.0	371.2
Wentworth	.5	24.9	199.2	99.6
Halton	.8	22.2	177.6	142.08
Peel	1.8	16.2	129.6	233.28
Dufferin	.3	31.8	254.4	76.32
Simcoe	.4	30.0	240.0	96.0
York	1.0	20.2	161.6	161.6
Metro Toronto	15.8	19.0	152.0	2,401.6
Durham	6.8	16.5	132.0	897.6
Victoria	.3	18.3	146.4	43.92
Haliburton	.4	23.5	188.0	75.2
Peterborough	2.4	12.0	96.0	230.4
Northumberland	2.6	5.5	44.0	114.4
Hastings	29.5	13.2	105.6	3,115.2
Renfrew	.1	28.9	231.2	23.12
Lennox Addington	.5	27.7	221.6	110.8
Frontenac	.5	15.1	120.8	60.4
Leeds	.9	23.0	184.0	165.6
Ottawa Carleton	2.6	29.7	237.6	617.76
Russell	.4	39.2	313.6	125.44
Timiskaming	.2	64.2	513.6	102.72
Algoma	.4	82.8	662.4	264.96
Quebec	.8	41.0	328.0	262.4
Illinois	.2	60.0	480.0	96.0
Ohio	.1	32.0	256.0	25.6
New York	.5	32.0	256.0	128.0
Michigan	.4	60.0	480.0	192.0
Minnesota	.3	60.0	400.0	144.0
	73.6		8,151.2	10,799.8

Average weighted one-way distance = 10,799.8 ÷ 73.6 = 146.73 km.

Average weighted round-trip distance = 293.46 km.

Table 5 - North Beach - Origin of Users

Map Scale: 1 cm = 8 km

Origin by County, District or Regional Municipality	Percent of Users	One-Way Distance On Map (cm)	Actual (cm)	Weighted (km)
Middlesex	.3	44.2	353.6	106.08
Wellington	.2	35.6	284.8	56.96
Niagara	.2	38.0	304.0	60.8
Wentworth	.3	29.3	234.4	70.32
Halton	.4	27.5	220.0	88.0
York	.2	23.0	184.0	36.8
Metro Toronto	2.6	20.7	165.6	430.56
Durham	1.8	20.0	160.0	288.0
Muskoka	.2	36.2	289.6	57.92
Peterborough	.2	16.0	128.0	25.6
Northumberland	10.6	11.1	88.8	941.28
Prince Edward	2.9	3.4	27.2	78.88
Hastings	72.1	13.8	110.4	7,959.84
Lennox Addington	.2	16.8	134.4	26.88
Frontenac	.3	21.2	169.6	50.88
Leeds	.2	21.5	172.0	34.4
Ottawa Carleton	1.5	33.3	266.4	399.6
Grenville	.1	21.5	172.0	17.2
Stormont	.4	32.0	256.0	102.4
Russell	.2	41.0	328.0	65.6
Sudbury	.1	55.1	440.8	44.08
Quebec	.7	36.2	289.6	202.72
Ohio	.2	35.1	280.8	56.16
New York	.4	35.1	280.8	112.32
	96.3		5,340.8	11,313.28

Average weighted one-way distance = 11,313.28 ÷ 96.3 = 117.48 km.

Average weighted round-trip distance = 234.96 km.

Annex H - Format Specifications for Canadian Water Level Data.

- Basis-of-Comparison minus plans in meters, conversion factor: 1 foot = .3048 meters.

- Data to be on IBM tape. If this is not possible, then data should be on cards.

- Format:

  (I5, 4A4, I5, 5F 10.5)

  1 - 5 year

  6 - 21 name of lake or river

  22 - 26 lake or river code (as given)

  27 - 36 May

  37 - 46 June

  47 - 56 July

  57 - 66 August

  67 - 76 September

- Lake and river codes are as follows:

Code	Lake or River
1.	Lake Huron
2.	St. Clair River
3.	Lake St. Clair
4.	Lake Erie
5.	Upper Niagara River
6.	Lake Ontario
7.	St. Lawrence River at Brookville-Morristown
8.	Lake St. Lawrence
9.	Lake St. Francis

- Major sort by year, i.e.; 1901 Lake Huron
  St. Clair River
  Lake St. Clair, etc.

  1902 Lake Huron
  St. Clair River
  Lake St. Clair, etc.

Environment Canada | Environnement Canada
867 Lakeshore Road, P.O. Box 5050
Burlington, Ontario
L7R 4A6

Our File No / Notre dossier 7054-5 124/30

Your File No / Votre dossier

INTERNATIONAL LAKE ERIE REGULATION STUDY

February 7, 1980

MEMORANDUM TO
MR. B. G. DE COOKE
CHAIRMAN, U.S. SECTION
REGULATION SUBCOMMITTEE

Subject: Additional Levels and Outflow Data Required by the Environmental Effects Subcommittee (EES) for Regulation Plan Evaluation

This request, as J. Urisk explained to Mr. Gregory during their telephone conversation early this afternoon, is for updated sets of the computer cards which you produced for us in early September. The cards which we now have do not include recent revisions in Lake Ontario level tabulations. We are also requesting a new set of cards for absolute Plan 77 BOC levels for Lakes Huron, St. Clair, Erie, and Ontario.

(A) For each regulation plan as input to the computerized beaches evaluation, we would require the following, preferably on IBM tape or, if this is not possible, on computer cards:

(1) Deviation (Plan 77 Basis of Comparison minus plan) in metres; conversion factor: one foot = .3048 metres.

(2) Format: (I5, 4A4, I5, 5F 10.5)

Columns 1 - 5 year,
" 6 - 21 name of lake or river,
" 22 - 26 lake or river code (as given),
" 27 - 36 May,
" 37 - 46 June,
" 47 - 56 July,
" 57 - 66 August, and
" 67 - 76 September.

(3) Lake codes are as follows:

Code	Lake
1.	Lake Huron,
3.	Lake St. Clair,
4.	Lake Erie, and
6.	Lake Ontario.

... 2

(4) Major sort by year:

i.e., 1901 Lake Huron, Lake St. Clair, etc., and
1902 Lake Huron, Lake St. Clair, etc.

(B) (1) Absolute Plan 77 Basis of Comparison levels in metres; conversion factor: one foot = .3048 metres.

(2) Format, coding and major sort as indicated above.

Please note that these items are of high priority. If feasible, we would like you to bring these cards to the February 13, 1980, Study Board meeting in Montreal. If that is not possible, we would like to receive the data by February 22, 1980 to permit our beach group to conduct its evaluation of the regulation plans.

We appreciate your continuing assistance in this matter. Should you require any clarification regarding the request, J. Urisk would be pleased to discuss any of the above-noted aspects with you.

C. Cheng and D. Busch
Co-Chairmen
Environmental Effects Subcommittee

cc D. F. Witherspoon
A. Holder

Inputs to Program BEACH Patrick G. Buckley

A. Parameters - 1 card in Format (7I5,F10.4,I5,F5.3, I5)

The default values are specified in brackets. Leave blank for default values.

```
col  1-5 number of lakes (9)
     6-10 number of lakes with data
    11-15 number of months (5)
    16-20 number of beaches
    21-25 number of districts (14)
    26-30 number of district-lake combinations (18)
    31-35 number of regions (4)
    36-45 discount factor (percent) (8.50)
    46-50 discount base year (1979)
    51-55 wear-off rate (.02)
    56-60 put 1 to eliminate L. Huron, 0 otherwise
```

B. Supply Data - in Format (10X,5F10.3)

First, on Gt. Lakes day-use supply, 1 card per lake-district. Second, overnight supply, 1 card per lake-district. On each card:

```
col  1-10 identifiers
col 11-20 supply for May
    21-30 supply for June
    31-40 supply for July
    41-50 supply for August
    51-60 supply for September
```

C. Current Demand - in Format (10X,7F10.3)

First, home-based demand, 2 records per region. Second, non-home based demand, 2 records per region. On each card:

```
col  1-10 identifiers
col 11-20 ⎫
    21-30 ⎪
      .   ⎬ demand by Districts
      .   ⎪
      .   ⎪
    71-80 ⎭
```

D. Demand Factors - 1 card per District in Format (10X,6F5.3)

On each card:

```
col  1-10 identifiers
    11-15 fraction of home-based swimming in natural environment
    16-20 fraction of home-based swimming in public areas
```

21-25 fraction of non-home based swimming in natural environment
26-30 fraction of non-home based swimming in public areas
31-35 fraction of swimming done by non-residents
36-40 per cent of total supply on Great Lakes

E. Per Cent Demand per Month - 1 card per District in Format (10X,5F5.4)

col 1-10 identifiers
col 11-15 fraction (%) in May
col 16-20 fraction (%) in June
col 21-25 fraction (%) in July
col 26-30 fraction (%) in August
col 31-35 fraction (%) in September

F. Value of Opportunity - 1 card in Format (10X,14F5.2)

col 1-10 identifiers
col 11-15, 16-20, . . . 76-80 } value of an opportunity for each District in Dollars and Cents

G. 1973/74 Population - 1 card in Format (10X,4F10.0)

col 1-10 identifiers
col 11-20, . . . 41-50 } population by Region (S.W., Central, Eastern, Algonquin)

H. Supply Factors

Space standard is set in program: SF1 = 9.29
Turnover rate is set in program: SF3 = 1.2
Input 1 card per District in Format (5X,5F5.1,5X,5F5.3)

col 1-5 identifiers
col 6-10, 11-15, 16-20, 21-25, 26-30 } days per month available

col 36-40, 41-45, 46-50, 51-55, 56-60 } Institutional Constraint Factor for each month

I. Beach Data - 1 card per 2 beaches in Format (2(10X,2F10.0,2F5.0))

col 1-10 identifiers Beach 1
11-20 length Beach 1
21-25 water level Beach 1
26-30 wet beach width Beach 1
31-35 lake code Beach 1
36-40 district code Beach 1

col 41-50 identifiers Beach 2
51-60 length Beach 2
61-65 water level Beach 2
66-70 wet beach width Beach 2
71-75 lake code Beach 2
76-80 district code Beach 2

J. Scenario Name - 1 card in Format (20A4)

Type name on 1 card.

K. Population Card for Each Year - in Format (I5,4F10.0)

col 1-5 Year (e.g. 1991)
col 6-15 Southwestern
16-25 Central
26-35 Eastern
36-45 Algonquin

$\}$ Population by Region for year

L. Hydrographs for Each Year in Format (I5, 16X,I5,5F10.5)

col 1-5 Year
col 6-21 Name of lake
col 22-26 numerical code for lake
27-36
37-46
47-56
57-66
67-76

$\}$ Hydrographs for each month

NOTE: Order of K and L

for each year have:

1. population card (K.)
2. hydrograph card for each lake (L.)

follow with next year's population card, lake cards, etc.
(i.e. major sort is by year, minor sort by lake).

Annex I - Stage-Value Relationship by Month and Reach (US)

POTENTIAL VALUE OF RECREATION BEACHES FOR ST. LAWRENCE (R008)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	11.49	27.79	41.69	33.64	19.68
+2	26.41	63.88	95.83	77.33	45.24
+1	33.87	81.92	122.90	99.18	58.01
REFERENCE WATER LEVEL 1/	41.33	99.96	149.97	121.03	70.79
-1	48.79	118.01	177.04	142.87	83.57
-2	56.25	136.05	204.11	164.72	96.35
-4	71.17	172.14	258.25	208.41	121.91
-6	86.09	208.23	312.39	252.10	147.46

1/ Reference water level for R008 is 241.8 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR ST. LAWRENCE (R007)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	0.00	0.00	0.00	0.00	0.00
+1	0.00	0.00	0.00	0.00	0.00
REFERENCE WATER LEVEL 1/	0.00	0.00	0.00	0.00	0.00
-1	0.00	0.00	0.00	0.00	0.00
-2	0.00	0.00	0.00	0.00	0.00
-4	0.00	0.00	0.00	0.00	0.00
-6	0.00	0.00	0.00	0.00	0.00

1/ Reference water level for R007 is 243.3 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR ST. LAWRENCE (R006)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	1.47	5.15	9.43	7.51	4.06
+1	4.13	14.49	26.52	21.12	11.41
REFERENCE WATER LEVEL [1]	6.79	23.84	43.62	34.73	18.77
-1	9.45	33.18	60.71	48.35	26.12
-2	12.11	42.52	77.81	61.96	33.48
-4	17.43	61.21	112.00	89.18	48.19
-6	22.75	79.90	146.19	116.41	62.90

[1] Reference water level for R006 is 244.9 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ONTARIO (2005)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	0.00	0.00	0.00	0.00	0.00
+1	2.14	7.53	13.78	10.97	5.93
REFERENCE WATER LEVEL 1/	6.36	22.34	40.87	32.54	17.58
-1	10.58	37.14	67.96	54.11	29.24
-2	14.79	51.95	95.05	75.68	40.89
-4	23.22	81.55	149.22	118.83	64.21
-6	31.66	111.16	203.40	161.97	87.52

1/ Reference water level for 2005 is 245.5 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ONTARIO (2004)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	0.00	0.00	0.00	0.00	0.00
+1	19.30	67.78	124.02	98.76	53.36
REFERENCE WATER LEVEL 1/	43.28	152.00	278.12	221.46	119.66
-1	67.26	236.21	432.21	344.17	185.96
-2	91.25	320.43	586.30	466.87	252.27
-4	139.21	488.86	894.49	712.28	384.87
-6	187.17	657.30	1202.68	957.68	517.47

1/ Reference water level for 2004 is 245.5 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ONTARIO (2003)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	12.53	45.05	82.43	65.64	35.47
+1	35.29	123.93	226.76	180.57	97.57
REFERENCE WATER LEVEL 1/	57.75	202.81	371.09	295.50	159.67
-1	80.21	281.69	515.42	410.42	221.77
-2	102.68	360.57	659.75	525.35	283.87
-4	147.60	518.33	948.41	755.21	408.07
-6	192.52	676.09	1237.08	985.07	532.27

1/ Reference water level for 2003 is 245.5 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ONTARIO (2002)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	18.04	63.34	115.90	92.29	49.87
+2	32.13	112.82	216.43	164.38	88.82
+1	39.17	137.56	251.70	200.42	108.30
REFERENCE WATER LEVEL [1/]	46.22	162.30	296.97	236.47	127.77
-1	53.26	187.04	342.23	272.52	147.25
-2	60.31	211.78	387.50	308.56	166.73
-4	74.40	261.26	478.03	380.65	205.68
-6	88.49	310.74	568.57	452.75	244.63

[1/] Reference water level for 2002 is 245.5.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ONTARIO (2001)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	12.67	42.39	77.57	61.77	33.37
+2	30.92	108.57	198.66	158.19	85.48
+1	40.34	141.67	259.21	206.41	111.53
REFERENCE WATER LEVEL 1/	49.76	174.76	319.76	254.62	137.58
-1	59.19	207.85	380.31	302.84	163.63
-2	68.61	240.94	440.86	351.05	189.68
-4	87.46	307.12	561.95	447.48	241.79
-6	106.30	373.30	683.05	543.91	293.89

1/ Reference water level for 2001 is 245.5 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR NIAGARA RIVER(R005)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	0.00	0.00	0.00	0.00	0.00
+1	0.00	0.00	0.00	0.00	0.00
REFERENCE WATER LEVEL 1/	0.00	0.00	0.00	0.00	0.00
-1	0.00	0.00	0.00	0.00	0.00
-2	0.00	0.00	0.00	0.00	0.00
-4	0.00	0.00	0.00	0.00	0.00
-6	0.00	0.00	0.00	0.00	0.00

1/ Reference water level for R005 is 245.5 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR NIAGARA RIVER(R004)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	4.66	15.55	23.71	20.31	13.34
+1	9.56	31.88	48.62	41.65	27.36
REFERENCE WATER LEVEL 1/	14.45	48.21	73.54	62.99	41.37
-1	19.35	64.54	98.45	84.33	55.39
-2	24.25	80.88	123.36	105.67	69.40
-4	34.04	113.54	173.19	148.35	97.44
-6	43.83	146.21	223.01	191.03	125.47

1/ Reference water level for R004 is 563.9 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ERIE (3003)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	35.53	118.50	180.75	154.83	101.69
+2	325.47	1085.70	1656.00	1418.51	931.68
+1	470.45	1569.29	2393.63	2050.35	1346.67
REFERENCE WATER LEVEL[1/]	615.42	2052.89	3131.25	2682.18	1761.67
-1	760.39	2536.49	3868.88	3314.02	2176.66
-2	905.37	3020.08	4606.50	3945.86	2591.65
-4	1195.31	3987.27	6081.75	5209.54	3421.64
-6	1485.26	4954.47	7557.00	6473.21	4251.62

[1/] Reference water level for 3003 is 571.3 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ERIE (3002)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	0.00	0.00	0.00	0.00	0.00
+1	48.26	160.99	245.55	210.34	135.15
REFERENCE WATER LEVEL 1/	130.47	435.22	663.83	568.63	373.48
-1	212.68	709.45	1082.11	926.92	608.80
-2	294.89	983.68	1500.39	1285.21	844.13
-4	459.31	1532.13	2336.95	2001.79	1314.78
-6	623.72	2080.59	3173.51	2718.38	1785.44

1/ Reference water level for 3002 is 571.3 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ERIE (3001)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	2.30	7.67	11.70	10.02	6.58
+2	7.55	25.53	38.94	33.35	21.91
+1	10.33	34.46	52.56	45.02	29.57
REFERENCE WATER LEVEL 1/	13.01	43.39	66.18	56.69	37.23
-1	15.68	52.32	79.80	68.35	44.99
-2	18.36	61.25	93.42	80.02	52.56
-4	23.71	79.11	120.66	103.35	67.88
-6	29.07	96.96	147.90	126.69	83.21

1/Reference water level for 3001 is 571.3 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR DETROIT RIVER (R003)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	3.45	9.22	13.50	11.89	8.73
+1	5.77	15.40	22.55	19.87	14.58
REFERENCE WATER LEVEL 1/	8.09	21.59	31.61	27.85	20.44
-1	10.40	27.77	40.67	35.82	26.29
-2	12.72	33.95	49.73	43.80	32.15
-4	17.35	46.32	67.84	59.76	43.86
-6	21.99	58.69	85.95	75.71	55.56

1/ Reference water level for R003 is 573.1 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR LAKE ST CLAIR (R002)
100.SQ. FT./PERSON (*1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	6.47	17.27	25.29	22.28	16.35
+1	12.87	34.35	50.31	44.32	32.53
REFERENCE WATER LEVEL 1/	19.27	51.44	75.34	66.36	48.70
-1	25.67	68.53	100.36	88.41	64.88
-2	32.08	85.62	125.39	110.45	81.06
-4	44.88	119.79	175.43	154.54	113.41
-6	57.68	153.97	225.48	198.62	145.77

1/ Reference water level for R002 is 574.1 IGLD.

POTENTIAL VALUE OF RECREATION BEACHES FOR ST CLAIR RIVER(R-01)
100.SQ. FT./PERSON ($1000)

WATER LEVEL FLUCTUATIONS	MAY	JUNE	JULY	AUGUST	SEPTEMBER
+4	0.00	0.00	0.00	0.00	0.00
+2	0.00	0.00	0.00	0.00	0.00
+1	0.00	0.00	0.00	0.00	0.00
REFERENCE WATER LEVEL 1/	0.00	0.00	0.00	0.00	0.00
-1	0.00	0.00	0.00	0.00	0.00
-2	0.00	0.00	0.00	0.00	0.00
-4	0.00	0.00	0.00	0.00	0.00
-6	0.00	0.00	0.00	0.00	0.00

1/Reference water level is 575.9 IGLD.

Annex J - Potential Benefit Relationship by Month and Reach, 1985-2035 (US)

POTENTIAL BENEFITS OF RECREATION REACHES FOR ST. LAWRENCE (R006)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	32.92	47.84	115.00	65.53	21.63
1995	35.11	51.02	122.67	69.89	23.08
2005	37.62	54.67	131.43	74.89	24.72
2015	39.50	57.40	138.00	78.63	25.96
2025	41.38	60.14	144.57	82.38	27.20
2035	43.26	62.87	151.14	86.12	28.43

POTENTIAL BENEFITS OF RECREATION BEACHES FOR ST. LAWRENCE (R007)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00

AD-A114 591 INTERNATIONAL LAKE ERIE REGULATION STUDY BOARD F/G 13/2
LAKE ERIE WATER LEVEL STUDY. APPENDIX G. RECREATIONAL BEACHES A--ETC(U)
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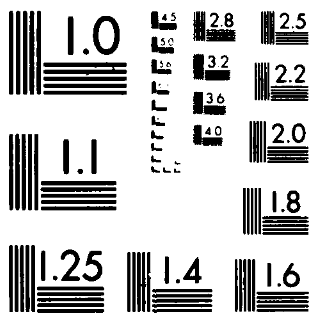

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

POTENTIAL BENEFITS OF RECREATION BEACHES FOR ST. LAWRENCE (R006)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	33.71	48.98	117.76	67.10	22.15
1995	36.15	52.53	126.29	71.96	23.76
2005	39.08	56.79	136.53	77.79	25.68
2015	41.52	60.34	145.06	82.65	27.29
2025	43.96	63.89	153.60	87.52	28.89
2035	46.41	67.44	162.13	92.38	30.50

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ONTARIO (2005)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	24.09	35.01	84.18	47.96	15.84
1995	26.46	38.46	92.46	52.68	17.39
2005	28.83	41.90	100.74	57.40	18.95
2015	30.41	44.20	106.26	60.54	19.99
2025	31.99	46.50	111.78	63.69	21.03
2035	33.57	48.79	117.30	66.83	22.07

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ONTARIO (2004)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	245.68	357.32	859.02	469.46	161.60
1995	259.97	377.79	908.25	517.50	170.86
2005	276.34	401.57	965.41	550.07	181.61
2015	286.33	416.10	1000.34	569.98	188.18
2025	296.33	430.63	1035.27	589.88	194.75
2035	306.33	445.16	1070.20	609.79	201.32

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ONTARIO (2003)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	261.61	380.17	913.95	520.75	171.93
1995	307.98	447.56	1075.96	613.06	202.40
2005	360.02	523.18	1257.76	716.65	236.60
2015	384.09	558.16	1341.86	764.57	252.42
2025	408.16	593.14	1425.95	812.49	268.24
2035	432.23	628.12	1510.05	860.41	284.06

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ONTARIO (2002)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	221.57	321.98	774.07	441.05	145.61
1995	261.38	379.84	913.16	520.31	171.78
2005	305.52	443.98	1067.37	608.17	200.79
2015	322.25	468.30	1125.83	641.48	211.79
2025	338.99	492.62	1184.29	674.79	222.78
2035	355.72	516.93	1242.75	708.10	233.78

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ONTARIO (2001)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	222.28	323.02	776.56	442.47	146.08
1995	252.52	366.96	882.20	502.66	165.95
2005	286.47	416.30	1000.61	570.25	188.27
2015	301.32	437.88	1052.71	599.82	198.03
2025	316.18	459.47	1104.60	629.38	207.79
2035	331.03	481.06	1156.49	658.95	217.55

POTENTIAL BENEFITS OF RECREATION BEACHES FOR NIAGARA RIVER(R005)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00

POTENTIAL BENEFITS OF RECREATION REACHES FOR NIAGARA RIVER(R004)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	180.93	262.93	632.10	360.16	118.91
1995	191.36	278.09	668.54	380.93	125.76
2005	205.22	298.22	716.95	408.50	134.87
2015	211.25	306.99	738.02	420.51	138.83
2025	217.28	315.75	759.09	432.52	142.80
2035	223.31	324.51	780.16	444.52	146.76

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ERIE (3004)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	4230.71	6148.07	14780.42	8421.66	2780.42
1995	4545.31	6605.25	15879.51	9047.90	2987.18
2005	4899.43	7119.85	17116.63	9752.80	3219.90
2015	5146.19	7478.44	17978.72	10244.00	3382.07
2025	5392.95	7837.03	18840.80	10735.20	3544.24
2035	5639.71	8195.62	19702.88	11226.40	3706.42

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ERIE (3003)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	4868.16	6987.22	16797.78	9571.12	3159.92
1995	5203.52	7561.76	18179.03	10358.13	3419.76
2005	5612.21	8155.66	19606.80	11171.66	3688.34
2015	5944.46	8638.52	20767.64	11833.08	3906.71
2025	6276.75	9121.38	21928.47	12494.51	4125.08
2035	6609.03	9604.24	23069.30	13155.93	4343.45

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ERIE (3002)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	2196.08	3191.35	7672.24	4371.52	1443.27
1995	2436.08	3540.11	8510.68	4849.25	1600.99
2005	2568.73	3878.20	9323.48	5312.38	1753.89
2015	2865.76	4164.52	10011.81	5704.57	1883.37
2025	3062.76	4450.63	10700.13	6096.77	2012.86
2035	3259.80	4737.15	11388.45	6468.97	2142.34

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ERIE (3001)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	245.44	356.67	857.46	488.56	161.30
1995	274.36	398.71	958.52	546.15	180.31
2005	303.29	440.74	1059.58	603.73	199.32
2015	326.80	474.90	1141.69	650.52	214.77
2025	350.30	509.06	1223.81	697.31	230.22
2035	4893.80	7111.68	17096.99	9741.61	3216.21

POTENTIAL BENEFITS OF RECREATION BEACHES FOR DETROIT RIVER (R003)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	218.02	316.82	761.66	433.98	143.26
1995	241.06	350.30	842.15	479.85	158.42
2005	261.07	379.39	912.08	519.69	171.58
2015	278.78	405.13	973.96	554.95	183.22
2025	296.50	430.87	1035.84	590.20	194.86
2035	314.21	456.61	1097.72	625.46	206.50

POTENTIAL BENEFITS OF RECREATION BEACHES FOR LAKE ST CLAIR (R002)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	587.26	853.41	2051.67	1169.01	385.95
1995	649.77	944.25	2270.05	1293.44	427.03
2005	704.22	1023.38	2460.28	1401.83	462.82
2015	752.42	1093.42	2628.66	1497.77	494.49
2025	800.62	1163.46	2797.05	1593.72	526.17
2035	848.82	1233.51	2965.44	1689.66	557.84

POTENTIAL BENEFITS OF RECREATION BEACHES FOR ST CLAIR RIVER(R001)
($1000)

YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1985	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00

Annex K - Canadian Stage-Value Data

Canadian stage-value data was combined with stage duration data used in the US method to measure the difference in average annual benefits on Canadian beaches on Lake Erie under the 25N regulation plan. The sensitivity test measures the difference in the Canadian simulation method with the US stage-duration method. Table 1 presents average annual value under BOC conditions and under 25N regulation plan and average annual benefits by Canadian reach on Lake Erie using the stage-duration method.

Table 1 - Average Annual Benefits Using Stage-Duration Method, 1979 Price Level 1/

Canadian Reach	PL-77 (BOC) ($000)	25N Plan ($000)	Benefit ($000)
Niagara	7,885	7,905	20
Simcoe	1,962	2,381	419
Aylmer	2,202	2,409	207
Chatham	6,567	7,446	879
Total	18,616	20,141	1,525

1/ Reflects price level adjustments from April 1977 to April 1979 (1.16875)

A listing of the HEC Expected Annual Damage Program used to compare Canadian and US methodologies is presented below with printouts of results (April 1977 price levels).

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TT      AVERAGE ANNUAL DAMAGE ANALYSIS  JON BROWN AUGUST 1980
TT      IJC BEACHES WATER LEVEL IMPACT
TT      THIS ANALYSIS EVALUATES IMPACTS OF ONE  LAKE REGULATION PLAN
TT      IT EVALUATES IMPACTS OF THE 25N LAKE ERIE REG. PLAN ON CANADIAN BEACHES
TT      LAKE ERIE  REACH  E1  NIAGARA
TT      REACHES IN THIS STUDY ARE SUB-CATEGORIZED BYMONTH (MAY, JUN,...SEP)
TT       DAMAGE VALUES IN THOUSANDS OF DOLLARS
J1    50     1980     1985
J2  8.50     7.75
CN     1 BEACHES
PN     1 ER7 77 PLAN
PN     2 ER5 25N PLAN
DY     6     1985     1995     2005     2015     2025     2035
PP                       6
RN REACH E1 NIAGARA (MAY)
FR ER7MY        15    100.0     92.2     88.3     87.0     85.7     46.8     44.2     13.0
FR  11.7       9.1      7.8      6.5      5.2      3.9      1.3
SF ER7MY         1    569.3    569.9    570.0    570.1    570.3    571.3    571.5    572.3
SF 572.4     572.6    572.9    572.9    573.0    573.2    573.5
SD               4    569.3    570.8    573.0    580.4
DG  E1MY1985          504.1    504.1    504.1        0
DG  E1MY1995          550.2    550.2    550.2        0
DG  E1MY2005          579.1    579.1    579.1        0
DG  E1MY2015          594.8    594.8    594.8        0
DG  E1MY2025          597.9    597.9    597.9        0
DG  E1MY2035          586.7    586.7    586.7        0
EP
FR ER5MY        17    100.0     97.4     96.1     92.2     90.9     66.2     64.9     57.1
FR  55.8      28.6     27.3      9.1      7.8      5.2      3.9      2.6      1.3
SF ER5MY         2    569.1    569.2    569.5    569.6    569.7    570.2    570.3    570.5
SF 570.6     571.1    571.2    571.6    571.8    572.0    572.3    572.4    572.4
ER
RN REACH E1 NIAGARA (JUNE)
FR ER7JN        18    100.0     98.7     94.8     93.5     92.2     87.0     80.5     79.2
FR  18.2      16.9     15.6      9.1      7.8      6.5      5.2      3.9      2.6      1.3
SF ER7JN         1    569.3    569.6    569.7    569.8    569.8    570.4    570.5    570.6
SF 572.3     572.3    572.4    572.5    572.9    573.0    573.0    573.1    573.5    573.6
SD               4    569.3    571.0    573.0    580.6
DG  E1JN1985         1018.8   1018.8   1018.8        0
DG  E1JN1995         1111.6   1111.6   1111.6        0
DG  E1JN2005         1169.9   1169.9   1169.9        0
DG  E1JN2015         1202.4   1202.4   1202.4        0
DG  E1JN2025         1208.0   1208.0   1208.0        0
DG  E1JN2035         1185.7   1185.7   1185.7        0
EP
FR ER5JN        17    100.0     98.7     90.9     88.3     84.4     83.1     81.8     66.2
FR  42.9      41.6     11.7     10.4      9.1      6.5      5.2      3.9      1.3
SF ER5JN         2    569.3    569.4    569.7    569.8    570.0    570.0    570.1    570.5
SF 570.9     571.0    571.6    571.7    571.9    572.0    572.2    572.2    572.5
ER
RN REACH E1 NIAGARA (JULY)
FR ER7JL        16    100.0     97.4     90.9     89.6     88.3     85.7     80.5     79.2
FR  67.5      63.6     14.3     13.0     10.4      5.2      3.9      1.3
SF ER7JL         1    569.3    569.6    569.8    570.0    570.3    570.4    570.5    570.6
SF 570.8     571.1    572.3    572.4    572.5    572.9    573.1    573.5
SD               4    569.3    571.1    572.9    580.5
DG  E1JL1985         2629.9   2629.9   2629.9        0
DG  E1JL1995         2869.3   2869.3   2869.3        0
DG  E1JL2005         3019.9   3019.9   3019.9        0
DG  E1JL2015         3103.1   3103.1   3103.1        0
DG  E1JL2025         3118.3   3118.3   3118.3        0
DG  E1JL2035         3059.5   3059.5   3059.5        0
EP
FR ER5JL        16    100.0     87.0     85.7     83.1     81.8     49.4     46.8     11.7
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FR  10.4     9.1     7.8     6.5     5.2     3.9     2.6     1.3
SF ER5JL       2   569.3   569.8   569.9   569.9   570.1   570.7   570.9   571.6
SF 571.6   571.7   571.7   571.9   572.0   572.1   572.2   572.4
ER
RN REACH E1 NIAGARA (AUGUST)
FR ER7AG      15   100.0    98.7    93.5    89.6    88.3    59.7    58.4    15.6
FR  13.0     9.1     7.8     5.2     3.9     2.6     1.3
SF ER7AG       1   569.2   569.3   569.7   569.8   570.2   571.0   571.2   571.9
SF 572.2   572.3   572.5   572.6   572.8   572.9   573.2
SD             4   569.2   570.8   572.6   580.7
DG  E1AG1985      1739.9  1739.9  1739.9       0
DG  E1AG1995      1898.7  1898.7  1898.7       0
DG  E1AG2005      1998.1  1998.1  1998.1       0
DG  E1AG2015      2052.8  2052.8  2052.8       0
DG  E1AG2025      2063.1  2063.1  2063.1       0
DG  E1AG2035      2024.4  2024.4  2024.4       0
EP
FR ER5AG      17   100.0    97.4    96.1    94.8    93.5    84.4    81.8    58.4
FR  57.1    22.1    20.8    11.7     9.1     5.2     3.9     2.6     1.3
SF ER5AG       2   569.1   569.2   569.3   569.3   569.4   569.7   570.0   570.4
SF 570.4   571.1   571.2   571.3   571.5   571.6   571.8   571.8   572.1
ER
RN REACH E1 NIAGARA (SEPTEMBER)
FR ER7SP      16   100.0    90.9    89.6    84.4    83.1    77.9    76.6    66.2
FR  63.6    32.5    31.2    13.0    10.4     6.5     2.6     1.3
SF ER7SP       1   569.0   569.6   569.8   569.9   570.1   570.2   570.3   570.5
SF 570.7   571.2   571.3   571.8   572.1   572.2   572.7   572.7
SD             4   569.1   570.6   572.2   580.5
DG  E1SP1985       377.3   377.3   377.3       0
DG  E1SP1995       411.8   411.8   411.8       0
DG  E1SP2005       433.6   433.6   433.6       0
DG  E1SP2015       445.3   445.3   445.3       0
DG  E1SP2025       447.8   447.8   447.8       0
DG  E1SP2035       439.2   439.2   439.2       0
EP
FR ER5SP      16   100.0    98.7    94.8    93.5    84.4    83.1    75.3    74.0
FR  67.5    66.2    14.3    13.0     7.8     3.9     2.6     1.3
SF ER5SP       2   568.8   569.0   569.0   569.2   569.6   569.7   569.8   569.9
SF 570.0   570.1   570.9   571.0   571.1   571.4   571.7   571.7
EJ
TT      AVERAGE ANNUAL DAMAGE ANALYSIS  JON BROWN AUGUST 1980
TT      IJC REACHES WATER LEVEL IMPACT
TT      THIS ANALYSIS EVALUATES IMPACTS OF ONE  LAKE REGULATION PLAN
TT      IT EVALUATES IMPACTS OF THE 25N LAKE ERIE REG. PLAN ON CANADIAN BEACHES
TT      LAKE ERIE  REACH E2  SIMCOE
TT      REACHES IN THIS STUDY ARE SUB-CATEGORIZED BYMONTH (MAY, JUN,...SEP)
TT       DAMAGE VALUES IN THOUSANDS OF DOLLARS
J1    50    1980    1985
J2  8.50    7.75
CN     1 BEACHES
PN     1 ER7 77 PLAN
PN     2 ER5 25N PLAN
DY     6    1985    1995    2005    2015    2025    2035
PP                     6
RN REACH E2 SIMCOE (MAY)
FR ER7MY      15   100.0    92.2    88.3    87.0    85.7    46.8    44.2    13.0
FR  11.7     9.1     7.8     6.5     5.2     3.9     1.3
SF ER7MY       1   569.3   569.9   570.0   570.1   570.3   571.3   571.5   572.3
SF 572.4   572.6   572.9   572.9   573.0   573.2   573.5
SD             4   569.3   570.8   573.0   574.0
DG  E2MY            69.4    46.2    13.7       0
EP
FR ER5MY      17   100.0    97.4    96.1    92.2    90.9    66.2    64.9    57.1
FR  55.8    28.6    27.3     9.1     7.8     5.2     3.9     2.6     1.3
SF ER5MY       2   569.1   569.2   569.5   569.6   569.7   570.2   570.3   570.5
SF 570.6   571.1   571.2   571.6   571.8   572.0   572.3   572.4   572.4
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ER
RN REACH E2 SIMCOE (JUNE)
FR ER7JN       18    100.0     98.7     94.8     93.5     92.2     87.0     80.5     79.2
FR  18.2     16.9     15.6      9.1      7.8      6.5      5.2      3.9      2.6      1.3
SF ER7JN        1    569.3    569.6    569.7    569.8    569.8    570.4    570.5    570.6
SF 572.3    572.3    572.4    572.5    572.9    573.0    573.0    573.1    573.5    573.6
SD              4    569.3    571.0    573.0    574.0
DG  E2JN1985         486.2    321.2    106.9        0
DG  F2JN1995         500.0    321.2    106.9        0
EP
FR ER5JN       17    100.0     98.7     90.9     88.3     84.4     83.1     81.8     66.2
FR  42.9     41.6     11.7     10.4      9.1      6.5      5.2      3.9      1.3
SF ER5JN        2    569.3    569.4    569.7    569.8    570.0    570.0    570.1    570.5
SF 570.9    571.0    571.6    571.7    571.9    572.0    572.2    572.2    572.5
ER
RN REACH E2 SIMCOE (JULY)
FR ER7JL       16    100.0     97.4     90.9     89.6     88.3     85.7     80.5     79.2
FR  67.5     63.6     14.3     13.0     10.4      5.2      3.9      1.3
SF ER7JL        1    569.3    569.6    569.8    570.0    570.3    570.4    570.5    570.6
SF 570.8    571.1    572.3    572.4    572.5    572.9    573.1    573.5
SD              4    569.3    571.1    572.9    574.0
DG  E2JL             977.5    603.7    223.1        0
EP
FR ER5JL       16    100.0     87.0     85.7     83.1     81.8     49.4     46.8     11.7
FR  10.4      9.1      7.8      6.5      5.2      3.9      2.6      1.3
SF ER5JL        2    569.3    569.8    569.9    569.9    570.1    570.7    570.9    571.6
SF 571.6    571.7    571.7    571.9    572.0    572.1    572.2    572.4
ER
RN REACH E2 SIMCOE (AUGUST)
FR ER7AG       15    100.0     98.7     93.5     89.6     88.3     59.7     58.4     15.6
FR  13.0      9.1      7.8      5.2      3.9      2.6      1.3
SF ER7AG        1    569.2    569.3    569.7    569.8    570.2    571.0    571.2    571.9
SF 572.2    572.3    572.5    572.6    572.8    572.9    573.2
SD              4    569.2    570.8    572.6    574.1
DG  E2AG1985        1021.2    713.1    321.2        0
DG  E2AG1995        1108.1    713.1    321.2        0
DG  E2AG2005        1159.9    713.1    321.2        0
DG  E2AG2015        1186.8    713.1    321.2        0
DG  E2AG2025        1186.8    713.1    321.2        0
DG  E2AG2035        1055.0    713.1    321.2        0
EP
FR ER5AG       17    100.0     97.4     96.1     94.8     93.5     84.4     81.8     58.4
FR  57.1     22.1     20.8     11.7      9.1      5.2      3.9      2.6      1.3
SF ER5AG        2    569.1    569.2    569.3    569.3    569.4    569.7    570.0    570.4
SF 570.4    571.1    571.2    571.3    571.5    571.6    571.8    571.8    572.1
ER
RN REACH E2 SIMCOE (SEPTEMBER)
FR ER7SP       16    100.0     90.9     89.6     84.4     83.1     77.9     76.6     66.2
FR  63.6     32.5     31.2     13.0     10.4      6.5      2.6      1.3
SF ER7SP        1    569.0    569.6    569.8    569.9    570.1    570.2    570.3    570.5
SF 570.7    571.2    571.3    571.8    572.1    572.2    572.7    572.7
SD              4    569.1    570.6    572.2    574.0
DG  E2SP1985         183.7    183.7    183.7        0
DG  E2SP1995         199.4    199.4    195.6        0
DG  E2SP2005         208.7    208.7    195.6        0
DG  E2SP2015         213.1    213.1    195.6        0
DG  E2SP2025         213.1    213.1    195.6        0
DG  E2SP2035         207.5    207.5    195.6        0
EP
FR ER5SP       16    100.0     98.7     94.8     93.5     84.4     83.1     75.3     74.0
FR  67.5     66.2     14.3     13.0      7.8      3.9      2.6      1.3
SF ER5SP        2    568.8    569.0    569.0    569.2    569.6    569.7    569.8    569.9
SF 570.0    570.1    570.9    571.0    571.1    571.4    571.7    571.7
EJ
TT      AVERAGE ANNUAL DAMAGE ANALYSIS  JON BROWN AUGUST 1980
TT      IJC REACHES WATER LEVEL IMPACT
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TT      THIS ANALYSIS EVALUATES IMPACTS OF ONE  LAKE REGULATION PLAN
TT      IT EVALUATES IMPACTS OF THE 25N LAKE ERIE REG. PLAN ON CANADIAN BEACHES
TT      LAKE ERIE  REACH E3  AYLMER
TT      REACHES IN THIS STUDY ARE SUB-CATEGORIZED BY MONTH (MAY, JUN, ...SEP)
TT      DAMAGE  VALUES IN THOUSANDS OF DOLLARS
J1     50     1980     1985
J2   8.50     7.75
CN      1 BEACHES
PN      1 ER7 77 PLAN
PN      2 ERS 25N PLAN
DY      6     1985     1995     2005     2015     2025     2035
PP                        6
RN REACH E3 AYLMER (MAY)
FR ER7MY       15    100.0     92.2     88.3     87.0     85.7     46.8     44.2     13.0
FR  11.7      9.1      7.8      6.5      5.2      3.9      1.3
SF ER7MY        1    569.3    569.9    570.0    570.1    570.3    571.3    571.5    572.3
SF 572.4    572.6    572.9    572.9    573.0    573.2    573.5
SD              4    569.3    570.8    573.0    577.6
DG  E3MY             149.9    122.6     82.7        0
EP
FR ERSMY       17    100.0     97.4     96.1     92.2     90.9     66.2     64.9     57.1
FR  55.8     28.6     27.3      9.1      7.6      5.2      3.9      2.6      1.3
SF ERSMY        2    569.1    569.2    569.5    569.6    569.7    570.2    570.3    570.5
SF 570.6    571.1    571.2    571.6    571.8    572.0    572.3    572.4    572.4
ER
RN REACH E3 AYLMER (JUNE)
FR ER7JN       18    100.0     98.7     94.8     93.5     92.2     87.0     80.5     79.2
FR  18.2     16.9     15.6      9.1      7.8      6.5      5.2      3.9      2.6      1.3
SF ER7JN        1    569.3    569.6    569.7    569.8    569.8    570.4    570.5    570.6
SF 572.3    572.3    572.4    572.5    572.9    573.0    573.0    573.1    573.5    573.6
SD              4    569.3    571.1    573.0    577.7
DG  E3JN             284.4    227.3    159.4        0
EP
FR ERSJN       17    100.0     98.7     90.9     88.3     84.4     83.1     81.8     66.2
FR  42.9     41.6     11.7     10.4      9.1      6.5      5.2      3.9      1.3
SF ERSJN        2    569.3    569.4    569.7    569.8    570.0    570.0    570.1    570.5
SF 570.9    571.0    571.6    571.7    571.9    572.0    572.2    572.2    572.5
ER
RN REACH E3 AYLMER (JULY)
FR EP7JL       16    100.0     97.4     90.9     89.6     88.3     85.7     80.5     79.2
FR  67.5     63.6     14.3     13.0     10.4      5.2      3.9      1.3
SF ER7JL        1    569.3    569.6    569.8    570.0    570.3    570.4    570.5    570.6
SF 570.8    571.1    572.3    572.4    572.5    572.9    573.1    573.5
SD              4    569.3    571.1    572.9    577.6
DG  F3JL             744.3    584.3    421.8        0
EP
FR ERSJL       16    100.0     87.0     85.7     83.1     81.8     49.4     46.8     11.7
FR  10.4      9.1      7.8      6.5      5.2      3.9      2.6      1.3
SF ERSJL        2    569.3    569.8    569.9    569.9    570.1    570.7    570.9    571.6
SF 571.6    571.7    571.7    571.9    572.0    572.1    572.2    572.4
ER
RN REACH E3 AYLMER (AUGUST)
FR ER7AG       15    100.0     98.7     93.5     89.6     88.3     59.7     58.4     15.6
FR  13.0      9.1      7.8      5.2      3.9      2.6      1.3
SF ER7AG        1    569.2    569.3    569.7    569.8    570.2    571.0    571.2    571.9
SF 572.2    572.3    572.5    572.6    572.8    572.9    573.2
SD              4    569.2    570.8    572.6    577.8
DG  E3AG             802.0    649.1    483.7        0
EP
FR ERSAG       17    100.0     97.4     96.1     94.8     93.5     84.4     81.8     58.4
FR  57.1     22.1     20.8     11.7      9.1      5.2      3.9      2.6      1.3
SF ERSAG        2    569.1    569.2    569.3    569.3    569.4    569.7    570.0    570.4
SF 570.4    571.1    571.2    571.3    571.5    571.6    571.8    571.8    572.1
ER
RN REACH E3 AYLMER (SEPTEMBER)
FR ER7SP       16    100.0     90.9     89.6     84.4     83.1     77.9     76.6     66.2
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FR  63.6     32.5     31.2     13.0     10.4      6.5      2.6      1.3
SF ER7SP       1     569.0    569.6    569.6    569.9    570.1    570.2    570.3    570.5
SF 570.7    571.2    571.3    571.8    572.1    572.2    572.7    572.7
SD             4     569.1    570.6    572.2    577.7
DG  E3SP1985         413.5    408.2    315.9        0
DG  E3SP1995         446.2    408.2    315.9        0
DG  E3SP2005         464.1    408.2    315.9        0
DG  E3SP2015         472.4    408.2    315.9        0
DG  E3SP2025         469.4    408.2    315.9        0
DG  E3SP2035         452.2    408.2    315.9        0
EP
FR ER5SP      16     100.0     98.7     94.8     93.5     84.4     83.1     75.3     74.0
FR  67.5     66.2     14.3     13.0      7.8      3.9      2.6      1.3
SF ER5SP       2     568.8    569.0    569.0    569.2    569.6    569.7    569.8    569.9
SF 570.0    570.1    570.9    571.0    571.1    571.4    571.7    571.7
EJ
TT       AVERAGE ANNUAL DAMAGE ANALYSIS  JON BROWN AUGUST 1980
TT       IJC REACHES WATER LEVEL IMPACT
TT       THIS ANALYSIS EVALUATES IMPACTS OF ONE  LAKE REGULATION PLAN
TT       IT EVALUATES IMPACTS OF THE 25N LAKE ERIE REG. PLAN ON CANADIAN BEACHES
TT       LAKE ERIE  REACH E4  CHATHAM
TT       REACHES IN THIS STUDY ARE SUB-CATEGORIZED BY MONTH (MAY, JUN, ...SEP)
TT       DAMAGE  VALUES IN THOUSANDS OF DOLLARS
J1    50     1980     1985
J2  8.50     7.75
CN     1 BEACHES
PN     1 ER7 77 PLAN
PN     2 ER5 25N PLAN
DY     6     1985     1995     2005     2015     2025     2035
PP                       6
RN REACH E4 CHATHAM (MAY)
FR ER7MY      15     100.0     92.2     88.3     87.0     85.7     46.8     44.2     13.0
FR  11.7      9.1      7.8      6.5      5.2      3.9      1.3
SF ER7MY       1     569.3    569.9    570.0    570.1    570.3    571.3    571.5    572.3
SF 572.4    572.6    572.9    572.9    573.0    573.2    573.5
SD             4     569.3    570.8    573.0    575.2
DG  E4MY             499.2    370.8    186.6        0
EP
FR ER5MY      17     100.0     97.4     96.1     92.2     90.9     66.2     64.9     57.1
FR  55.8     28.6     27.3      9.1      7.8      5.2      3.9      2.6      1.3
SF ER5MY       2     569.1    569.2    569.5    569.6    569.7    570.2    570.3    570.5
SF 570.6    571.1    571.2    571.6    571.8    572.0    572.3    572.4    572.4
ER
RN REACH E4 CHATHAM (JUNE)
FR ER7JN      18     100.0     98.7     94.8     93.5     92.2     87.0     80.5     79.2
FR  18.2     16.9     15.6      9.1      7.8      6.5      5.2      3.9      2.6      1.3
SF ER7JN       1     569.3    569.6    569.7    569.8    569.8    570.4    570.5    570.6
SF 572.3    572.3    572.4    572.5    572.9    573.0    573.0    573.1    573.5    573.6
SD             4     569.3    571.1    573.0    575.3
DG  E4JN            1439.8   1035.8    551.4        0
EP
FR ER5JN      17     100.0     98.7     90.9     88.3     84.4     83.1     81.8     66.2
FR  42.9     41.6     11.7     10.4      9.1      6.5      5.2      3.9      1.3
SF ER5JN       2     569.3    569.4    569.7    569.8    570.0    570.0    570.1    570.5
SF 570.9    571.0    571.6    571.7    571.9    572.0    572.2    572.2    572.5
ER
RN REACH E4 CHATHAM (JULY)
FR ER7JL      16     100.0     97.4     90.9     89.6     88.3     85.7     80.5     79.2
FR  67.5     63.6     14.3     13.0     10.4      5.2      3.9      1.3
SF ER7JL       1     569.3    569.6    569.8    570.0    570.3    570.4    570.5    570.6
SF 570.8    571.1    572.3    572.4    572.5    572.9    573.1    573.5
SD             4     569.3    571.1    572.9    575.2
DG  E4JL            2559.7   1791.6   1010.6        0
EP
FR ER5JL      16     100.0     87.0     85.7     83.1     81.8     49.4     46.8     11.7
FR  10.4      9.1      7.8      6.5      5.2      3.9      2.6      1.3
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SF ER5JL      2      569.3    569.8    569.9    569.9    570.1    570.7    570.9    571.6
SF 571.6    571.7    571.7    571.9    572.0    572.1    572.2    572.4
ER
RN REACH E4 CHATHAM (AUGUST)
FR ER7AG     15      100.0     98.7     93.5     89.6     88.3     59.7     58.4     15.6
FR  13.0      9.1      7.8      5.2      3.9      2.6      1.3
SF ER7AG      1      569.2    569.3    569.7    569.8    570.2    571.0    571.2    571.9
SF 572.2    572.3    572.5    572.6    572.8    572.9    573.2
SD            4      569.2    570.8    572.6    575.3
DG  E4AG            2495.9   1832.1   1114.4       .0
EP
FR ER5AG     17      100.0     97.4     96.1     94.8     93.5     84.4     81.8     58.4
FR  57.1     22.1     20.8     11.7      9.1      5.2      3.9      2.6      1.3
SF ER5AG      2      569.1    569.2    569.3    569.3    569.4    569.7    570.0    570.4
SF 570.4    571.1    571.2    571.3    571.5    571.6    571.8    571.8    572.1
ER
RN REACH E4 CHATHAM (SEPTEMBER)
FR ER7SP     16      100.0     90.9     89.6     84.4     83.1     77.9     76.6     66.2
FR  63.6     32.5     31.2     13.0     10.4      6.5      2.6      1.3
SF ER7SP      1      569.0    569.6    569.8    569.9    570.1    570.2    570.3    570.5
SF 570.7    571.2    571.3    571.8    572.1    572.2    572.7    572.7
SD            4      569.1    570.6    572.2    575.3
DG  E4SP1985         953.1    953.1    953.1        0
DG  E4SP1995        1027.7   1027.7   1027.7        0
DG  E4SP2005        1069.7   1069.7   1036.4        0
DG  E4SP2015        1088.2   1088.2   1036.4        0
DG  E4SP2025        1081.4   1081.4   1036.4        0
DG  E4SP2035        1042.5   1042.5   1036.4        0
EP
FR ER5SP     16      100.0     98.7     94.8     93.5     84.4     83.1     75.3     74.0
FR  67.5     66.2     14.3     13.0      7.8      3.9      2.6      1.3
SF ER5SP      2      568.8    569.0    569.0    569.2    569.6    569.7    569.8    569.9
SF 570.0    570.1    570.9    571.0    571.1    571.4    571.7    571.7
EJ
```

Niagara

Equivalent Annual Damage Summary by Reach

Input Data Years = 1985, 1995, 2005, 2015, 2025, 2035

Period of Analysis = 50 Years

Discount Rate = 8.5000 Percent

Flood Plain Management Plans

1 - ER7 77 Plan
2 - ER5 25N Plan

Summary for Damage Category 1 - Beaches

Reach		Equivalent Annual Damage		
		Without Condition (Plan 1)	Plan 2	
No.	ID		Damage W/Plan	Damage Reduced
1	ER5MY	542.67	543.92	-1.26
2	ER5JN	1096.24	1099.07	-2.83
3	ER5JL	2829.70	2836.98	-7.28
4	ER5AG	1872.93	1877.08	-4.15
5	ER5SP	406.03	407.15	-1.12
Beaches		6747.56	6764.20	-16.64

Simcoe

Equivalent Annual Damage Summary by Reach

Input Data Years = 1985, 1995, 2005, 2015, 2025, 2035

Period of Analysis = 50 Years

Discount Rate = 8.5000 Percent

Flood Plain Management Plans

1 - ER7 77 Plan
2 - ER5 25N Plan

Summary for Damage Category 1 - Beaches

Reach		Equivalent Annual Damage		
		Without Condition (Plan 1)	Plan 2	
No.	ID		Damage W/Plan	Damage Reduced
1	ER5MY	39.08	48.38	-9.30
2	ER5JN	267.89	340.08	-72.19
3	ER5JL	549.04	671.43	-122.39
4	ER5AG	630.60	780.76	-150.16
5	ER5SP	192.83	196.58	-3.75
Beaches		1679.44	2037.24	-357.79

Aylmer

Equivalent Annual Damage Summary by Reach

Input Data Years = 1985, 1995, 2005, 2015, 2025, 2035

Period of Analysis = 50 Years

Discount Rate = 8.5000 Percent

Flood Plain Management Plans

1 - ER7 77 Plan
2 - ER5 25N Plan

Summary for Damage Category 1 - Beaches

Reach No.	Reach ID	Equivalent Annual Damage: Without Condition (Plan 1)	Plan 2: Damage W/Plan	Plan 2: Damage Reduced
1	ER5MY	113.70	124.98	-11.27
2	ER5JN	212.49	235.93	-23.44
3	ER5JL	560.96	613.33	-52.37
4	ER5AG	613.27	675.53	-62.27
5	ER5SP	383.67	410.89	-27.23
Beaches		1884.09	2060.67	-176.58

Chatham

Equivalent Annual Damage Summary by Reach

Input Data Years = 1985, 1995, 2005, 2015, 2025, 2035

Period of Analysis = 50 Years

Discount Rate = 8.5000 Percent

Flood Plain Management Plans

1 - ER7 77 Plan
2 - ER5 25N Plan

Summary for Damage Category 1 - Beaches

Reach No.	Reach ID	Equivalent Annual Damage: Without Condition (Plan 1)	Plan 2: Damage W/Plan	Plan 2: Damage Reduced
1	ER5MY	329.96	382.36	-52.40
2	ER5JN	929.73	1096.50	-166.77
3	ER5JL	1679.15	1930.89	-251.74
4	ER5AG	1676.48	1946.89	-270.41
5	ER5SP	1004.09	1014.07	-9.98
Beaches		5619.41	6370.71	-751.30

Annex L - Descriptive Recreational Boating Statistics

Table 1 - Existing Utilization by Reach

Reach	Existing Utilization	
	Berths/Slips	Moorings
R001	2,467	0
R002	8,884	0
R003	4,326	0
3001	3,286	0
3002	13,296	13
3003	7,631	0
3004	2,528	133
R004	2,023	0
R005	151	225
2001	855	3
2002	744	0
2003	2,179	113
2004	32	0
2005	2,465	116
R006	1,171	0

Table 2 - Average Water Depth by Harbor and Reach

Reach/Harbor 1/	Water Depth					
	Berths/Slips			Moorings		
	Mean	SD	Sample No.	Mean	SD	Sample No.
Ogdensburg	5.8	3.1	17	0	0	0
Alexandria Bay	5.4	1.6	39	0	0	0
R006	5.3	2.2	98	0	0	0
Clayton	6.0	1.6	52	0	0	0
Cape Vincent	6.4	1.6	15	0	0	0
Chaumont Bay	4.3	1.4	24	9.3	1.5	4
Sacketts Harbor	8.2	3.0	19	0	0	0
Henderson Bay	4.4	1.3	50	10.0	0	8
2005	5.1	2.0	242	9.8	.9	12
North Pond	4.5	1.2	20	0	0	0
2004	6.1	1.7	4	0	0	0
Oswego	9.7	3.2	10	0	0	0
Little Sodus Bay	6.3	2.7	18	10.1	.5	4
Sodus Bay	6.0	2.9	48	9.0	2.8	12
Rochester	6.8	2.2	83	0	0	0
2003	6.2	2.6	204	9.3	2.4	16
Braddock Bay	4.2	1.8	49	0	0	0
2002	4.2	1.8	63	0	0	0
Oak Orchard	6.5	3.7	25	0	0	0
Olcott	9.5	2.6	16	11.7	0	1
Wilson	5.5	1.4	41	0	0	0
2001	6.6	2.9	82	11.7	0	1
Niagara River	6.2	2.5	136	0	0	0
R005	7.0	2.8	10	34.6	7.1	2
Grand Island	5.4	1.7	58	0	0	0
R004	6.0	2.3	199	0	0	0
Buffalo Harbor	10.1	1.7	63	6.3	1.0	3
Dunkirk	4.1	1.0	9	8.2	-.0	3
Presque Isle	8.5	2.4	146	6.0	2.7	3
3004	8.5	2.7	229	6.7	1.6	11
Conneaut	6.2	2.0	23	0	0	0
Fairport	5.5	2.5	50	0	0	0
Chayrin River	3.3	1.4	71	0	0	0
Cleveland	9.3	2.3	163	0	0	0
Rocky River	5.5	1.6	66	0	0	0
Lorain	8.8	1.4	12	0	0	0
Vermilion	4.9	1.7	100	0	0	0

Table 2 - Average Water Depth by Harbor and Reach (Cont'd)

Reach/Harbor 1/	Water Depth					
	Berths/Slips			Moorings		
	Mean	SD	Sample No.	Mean	SD	Sample No.
Huron	5.8	2.3	105	0	0	0
3003	6.2	2.8	787	10.3	0	1
Sandusky	6.2	2.4	293	6.4	0	1
East Harbor	5.0	1.0	192	0	0	0
West and Middle Harbor	5.4	1.3	238	0	0	0
Put-In-Bay	6.2	2.0	44	0	0	0
Catawba	6.0	2.1	213	0	0	0
Port Clinton	5.1	1.6	224	0	0	0
Toledo	7.0	1.5	105	0	0	0
3002	5.7	1.9	1,356	6.4	0	1
N. Maumee River	3.8	.8	147	0	0	0
Bolles Harbor	5.4	1.0	36	0	0	0
3001	4.6	1.4	289	0	0	0
Detroit River	7.3	2.0	157	0	0	0
St. Clair Shores	6.2	2.0	316	0	0	0
R003	6.2	2.1	389	0	0	0
Clinton River	5.8	1.8	243	0	0	0
Anchor Bay	4.9	1.4	136	0	0	0
North Channel	4.7	1.9	82	0	0	0
South Channel	3.8	.8	11	0	0	0
R002	6.0	2.0	865	0	0	0
St. Clair River	4.7	1.5	42	0	0	0
Black River	7.1	2.0	58	0	0	0
R001	5.5	2.2	213	0	0	0

1/ Average depths by reach include depth measurements from other facilities that are within the reach but not in the listed harbors.

Annex M - Boating Stage-Damage Computations by Reach

Table 1 - Stage Damage Computation, Reach R001

WATERWAY St. Clair River
REACH R001
AVERAGE DEPTH 5.5 Feet
ZERO REFERENCE WATER LEVEL 575.9

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value 1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.5		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	5.5		
6.0	Cruiser	>64	0	250,000	.075	0	0	5.5		
6.0	Other	>64	0	150,000	.10	0	0	5.5		
5.5	Cruiser	40-64	26	69,500	.075	135.5	135.5	5.5	135.5	575.9
5.0	Sail	26-40	0	7,890	.10	0	135.5	4.5		
5.0	Aux Sail	26-40	65	20,090	.075	97.9	233.4	4.5		
5.0	House/Pontoon	40-64	0	25,500	.10	0	233.4	4.5		
5.0	Other	40-64	0	34,430	.10	0	233.4	4.5	233.4	574.9
4.0	Sail	16-26	0	3,890	.10	0	233.4	3.5		
4.0	Aux Sail	16-26	209	9,500	.075	148.9	382.3	3.5		
4.0	Cruiser	26-40	548	24,340	.075	1,000.4	1,382.7	3.5		
4.0	House/Pontoon	26-40	117	15,500	.10	181.4	1,564.1	3.5		
4.0	Other	26-40	0	13,870	.10	0	1,564.1	3.5		
3.5	Cruiser	16-26	183	7,770	.075	106.6	1,670.7	3.5	1,670.7	573.9
3.0	Cruiser	<16	0	5,200	.075	0	1,670.7	2.5		
3.0	House/Pontoon	16-26	13	3,500	.10	4.6	1,675.3	2.5		
3.0	Other	16-26	0	6,050	.10	0	1,675.3	2.5		
3.0	In/Out	26-40	13	10,530	.125	17.1	1,692.4	2.5		
3.0	Inboard	26-40	13	13,530	.10	17.6	1,710.0	2.5		
2.5	Sail	<16	0	880	.10	0	1,710.0	2.5		
2.5	Aux Sail	<16	13	1,280	.075	1.2	1,711.2	2.5		
2.5	In/Out	16-26	875	6,180	.125	675.9	2,387.1	2.5		
2.5	Inboard	16-26	209	8,300	.10	173.5	2,560.6	2.5		
2.5	Outboard	40-64	0	6,200	.125	0	2,560.6	2.5	2,560.6	572.9
2.0	Inboard	<16	0	5,200	.10	0	2,560.6	1.5		
2.0	Other	<16	0	2,920	.10	0	2,560.6	1.5		
2.0	Outboard	26-40	0	5,200	.125	0	2,560.6	1.5		
1.5	Outboard	<16	157	1,160	.125	22.8	2,583.4	1.5		
1.5	In/Out	<16	0	3,800	.125	0	2,583.4	1.5		
1.5	Outboard	16-26	26	3,180	.125	10.3	2,593.7	1.5	2,593.7	571.9

1/ Cumulative totals may not add due to rounding.

Table 2 - Stage Damage Computation, Reach R002

WATERWAY Lake St. Clair
REACH R002
AVERAGE DEPTH 6.0
ZERO REFERENCE WATER LEVEL 574.1

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value[1/] ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	6.0		
6.0	Aux Sail	40-64	52	58,040	.075	226.4	226.4	6.0		
6.0	Cruiser	>64	0	250,000	.075	0	226.4	6.0		
6.0	Other	>64	0	150,000	.10	0	226.4	6.0	226.4	574.1
5.5	Cruiser	40-64	206	69,500	.075	1,073.8	1,300.2	5.0		
5.0	Sail	26-40	0	7,890	.10	0	1,300.2	5.0		
5.0	Aux Sail	26-40	867	20,090	.075	1,306.4	2,606.6	5.0		
5.0	House/Pontoon	40-64	41	25,500	.10	104.5	2,711.1	5.0		
5.0	Other	40-64	0	34,430	.10	0	2,711.1	5.0	2,711.1	573.1
4.0	Sail	16-26	10	3,890	.10	3.9	2,715.0			
4.0	Aux Sail	16-26	1,300	9,500	.075	926.3	3,641.3			
4.0	Cruiser	26-40	2,414	24,340	.075	4,406.8	8,048.1			
4.0	House/Pontoon	26-40	124	15,500	.10	192.2	8,240.3			
4.0	Other	26-40	10	13,870	.10	13.9	8,254.2	4.0	8,254.2	572.1
3.5	Cruiser	16-26	774	7,770	.075	451.1	8,705.3			
3.0	Cruiser	<16	0	5,200	.075	0	8,705.3			
3.0	House/Pontoon	16-26	0	3,500	.10	0	8,705.3			
3.0	Other	16-26	0	6,050	.10	0	8,705.3			
3.0	In/Out	26-40	165	10,530	.125	217.2	8,922.5			
3.0	Inboard	26-40	93	13,530	.10	125.8	9,048.3	3.0	9,048.3	571.1
2.5	Sail	<16	21	880	.10	1.8	9,050.1			
2.5	Aux Sail	<16	21	1,280	.075	2.1	9,052.2			
2.5	In/Out	16-26	2,084	6,180	.125	1,609.9	10,662.1			
2.5	Inboard	16-26	279	8,300	.10	231.6	10,893.7			
2.5	Outboard	40-64	0	6,200	.125	0	10,893.7			
2.0	Inboard	<16	0	5,200	.10	0	10,893.7			
2.0	Other	<16	0	2,920	.10	0	10,893.7			
2.0	Outboard	26-40	0	5,200	.125	0	10,893.7	2.0	10,893.7	570.1
1.5	Outboard	<16	165	1,160	.125	23.9	10,917.6			
1.5	In/Out	<16	10	3,800	.125	4.8	10,922.4			
1.5	Outboard	16-26	248	3,180	.125	98.6	11,021.0	1.0	11,021.0	569.1

1/ Cumulative totals may not add due to rounding.

Table 3 - Stage Damage Computation, Reach R003

WATERWAY Detroit River
REACH R003
AVERAGE DEPTH 6.2
ZERO REFERENCE WATER LEVEL 573.1

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value 1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.2		
6.0	Aux Sail	40-64	56	58,040	.075	243.8	243.8	5.2		
6.0	Cruiser	>64	11	250,000	.075	206.3	450.1	5.2		
6.0	Other	>64	0	150,000	.10	0	450.1	5.2		
5.5	Cruiser	40-64	189	69,500	.075	985.2	1,435.2	5.2	1,435.2	572.1
5.0	Sail	26-40	11	7,890	.10	8.7	1,443.9	4.2		
5.0	Aux Sail	26-40	289	20,090	.075	435.5	1,879.3	4.2		
5.0	House/Pontoon	40-64	33	25,500	.10	84.2	1,963.5	4.2		
5.0	Other	40-64	0	34,430	.10	0	1,963.5	4.2	1,963.5	571.1
4.0	Sail	16-26	56	3,890	.10	21.8	1,985.2	3.2		
4.0	Aux Sail	16-26	545	9,500	.075	388.3	2,373.6	3.2		
4.0	Cruiser	26-40	1,268	24,340	.075	2,314.7	4,688.3	3.2		
4.0	House/Pontoon	26-40	56	15,500	.10	86.8	4,775.1	3.2		
4.0	Other	26-40	0	13,870	.10	0	4,775.1	3.2		
3.5	Cruiser	16-26	311	7,770	.075	181.2	4,956.3	3.2	4,956.3	570.1
3.0	Cruiser	<16	0	5,200	.075	0	4,956.3	2.2		
3.0	House/Pontoon	16-26	0	3,500	.10	0	4,956.3	2.2		
3.0	Other	16-26	0	6,050	.10	0	4,956.3	2.2		
3.0	In/Out	26-40	78	10,530	.125	102.7	5,059.0	2.2		
3.0	Inboard	26-40	33	13,530	.10	44.6	5,103.6	2.2		
2.5	Sail	<16	0	880	.10	0	5,103.6	2.2		
2.5	Aux Sail	<16	0	1,280	.075	0	5,103.6	2.2		
2.5	In/Out	16-26	1,168	6,180	.125	902.3	6,005.9	2.2		
2.5	Inboard	16-26	89	8,300	.10	73.9	6,079.8	2.2		
2.5	Outboard	40-64	0	6,200	.125	0	6,079.8	2.2	6,079.8	569.1
2.0	Inboard	<16	0	5,200	.10	0	6,079.8	1.2		
2.0	Other	<16	0	2,920	.10	0	6,079.8	1.2		
2.0	Outboard	26-40	0	5,200	.125	0	6,079.8	1.2		
1.5	Outboard	<16	111	1,160	.125	16.1	6,095.9	1.2		
1.5	In/Out	<16	0	3,800	.125	0	6,095.9	1.2		
1.5	Outboard	16-26	22	3,180	.125	8.7	6,104.6	1.2	6,104.6	568.1

1/ Cumulative totals may not add due to rounding.

Table 4 - Stage Damage Computation, Reach 3001

WATERWAY Lake Erie
REACH 3001
AVERAGE DEPTH 4.6
ZERO REFERENCE WATER LEVEL 571.3

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.6		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	5.6		
6.0	Cruiser	>64	0	250,000	.075	0	0	5.6		
6.0	Other	>64	0	150,000	.10	0	0	5.6	0	572.3
5.5	Cruiser	40-64	11	69,500	.075	57.3	57.3	4.6		
5.0	Sail	26-40	0	7,890	.10	0	57.3	4.6		
5.0	Aux Sail	26-40	422	20,090	.075	635.8	693.2	4.6		
5.0	House/Pontoon	40-64	0	25,500	.10	0	693.2	4.6		
5.0	Other	40-64	0	34,430	.10	0	693.2	4.6	693.2	571.3
4.0	Sail	16-26	0	3,890	.10	0	693.2	3.6		
4.0	Aux Sail	16-26	331	9,500	.075	235.8	929.0	3.6		
4.0	Cruiser	26-40	514	24,340	.075	938.3	1,867.3	3.6		
4.0	House/Pontoon	26-40	46	15,500	.10	71.3	1,938.6	3.6		
4.0	Other	26-40	0	13,870	.10	0	1,938.6	3.6	1,938.6	570.3
3.5	Cruiser	16-26	171	7,770	.075	99.7	2,038.3	2.6		
3.0	Cruiser	<16	0	5,200	.075	0	2,038.3	2.6		
3.0	House/Pontoon	16-26	0	3,500	.10	0	2,038.3	2.6		
3.0	Other	16-26	0	6,050	.10	0	2,038.3	2.6		
3.0	In/Out	26-40	0	10,530	.125	0	2,038.3	2.6		
3.0	Inboard	26-40	46	13,530	.10	62.2	2,100.5	2.6	2,100.5	569.3
2.5	Sail	<16	0	880	.10	0	2,100.5	1.6		
2.5	Aux Sail	<16	0	1,280	.075	0	2,100.5	1.6		
2.5	In/Out	16-26	776	6,180	.125	599.5	2,700.0	1.6		
2.5	Inboard	16-26	251	8,300	.10	208.3	2,908.3	1.6		
2.5	Outboard	40-64	0	6,200	.125	0	2,908.3	1.6		
2.0	Inboard	<16	0	5,200	.10	0	2,908.3	1.6		
2.0	Other	<16	11	2,920	.10	3.2	2,911.5	1.6		
2.0	Outboard	26-40	0	5,200	.125	0	2,911.5	1.6	2,911.5	568.3
1.5	Outboard	<16	342	1,160	.125	49.6	2,961.1	.6		
1.5	In/Out	<16	11	3,800	.125	5.2	2,966.3	.6		
1.5	Outboard	16-26	354	3,180	.125	140.7	3,107.1	.6	3,107.1	567.3

1/ Cumulative totals may not add due to rounding.

Table 5 - Stage Damage Computation, Reach 3002

WATERWAY Lake Erie
REACH 3002
AVERAGE DEPTH 5.7
ZERO REFERENCE WATER LEVEL 571.3

BERTH/SLIP X
MOORING X

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value[1] ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.7		
6.0	Aux Sail	40-64	20	58,040	.075	87.1	87.1	5.7		
6.0	Cruiser	>64	0	250,000	.075	0	87.1	5.7		
6.0	Other	>64	10	150,000	.10	150.0	237.1	5.7	237.1	571.3
5.5	Cruiser	40-64	334	69,500	.075	1,741.0	1,978.1	4.7		
5.0	Sail	26-40	138	7,890	.10	108.9	2,086.9	4.7		
5.0	Aux Sail	26-40	521	20,090	.075	785.0	2,871.9	4.7		
5.0	House/Pontoon	40-64	20	25,500	.10	51.0	2,922.9	4.7		
5.0	Other	40-64	0	34,430	.10	0	2,922.9	4.7	2,922.9	570.3
4.0	Sail	16-26	88	3,890	.10	34.2	2,957.2	3.7		
4.0	Aux Sail	16-26	649	9,500	.075	462.4	3,419.6	3.7		
4.0	Cruiser	26-40	2,742	24,340	.075	5,005.5	8,425.1	3.7		
4.0	House/Pontoon	26-40	79	15,500	.10	122.5	8,547.5	3.7		
4.0	Other	26-40	20	13,870	.10	27.7	8,575.3	3.7	8,594.9[2]	569.3
3.5	Cruiser	16-26	1,110	7,770	.075	646.9	9,222.1	2.7		
3.0	Cruiser	<16	20	5,200	.075	7.8	9,229.9	2.7		
3.0	House/Pontoon	16-26	29	3,500	.10	10.2	9,240.1	2.7		
3.0	Other	16-26	10	6,050	.10	6.1	9,246.1	2.7		
3.0	In/Out	26-40	452	10,530	.125	594.9	9,841.1	2.7		
3.0	Inboard	26-40	383	13,530	.10	518.2	10,359.3	2.7	10,378.9[2]	568.3
2.5	Sail	<16	29	880	.10	2.6	10,361.8	1.7		
2.5	Aux Sail	<16	29	1,280	.075	2.8	10,364.6	1.7		
2.5	In/Out	16-26	3,194	6,180	.125	2,467.4	12,831.9	1.7		
2.5	Inboard	16-26	1,464	8,300	.10	1,215.1	14,047.1	1.7		
2.5	Outboard	40-64	0	6,200	.125	0	14,047.1	1.7		
2.0	Inboard	<16	49	5,200	.10	25.5	14,072.6	1.7		
2.0	Other	<16	20	2,920	.10	5.8	14,078.4	1.7		
2.0	Outboard	26-40	29	5,200	.125	18.9	14,097.3	1.7	14,116.9[2]	567.3
1.5	Outboard	<16	658	1,160	.125	95.4	14,192.7	.7		
1.5	In/Out	<16	157	3,800	.125	74.6	14,267.3	.7		
1.5	Outboard	16-26	1,042	3,180	.125	414.2	14,681.5	.7	14,701.1[2]	566.3

1/ Cumulative totals may not add due to rounding.

2/ Only 13 moored aux. sail 26'-40' are in reach 3002 and are included in berth/slip calculations (13 x $20,090 x .075 = $19,590). Ave. mooring depth is 6.4', therefore, this damage occurs at 569.3 IGLD when only 4.4 feet of depth is available.

Table 6 - Stage Damage Computation, Reach 3003

WATERWAY Lake Erie
REACH 3003
AVERAGE DEPTH 6.2
ZERO REFERENCE WATER LEVEL 571.3

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value[1/] ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	30	12,890	.10	38.7	38.7	5.2		
6.0	Aux Sail	40-64	0	58,040	.075	0	38.7	5.2		
6.0	Cruiser	>64	0	250,000	.075	0	38.7	5.2		
6.0	Other	>64	0	150,000	.10	0	38.7	5.2		
5.5	Cruiser	40-64	158	69,500	.075	823.6	862.2	5.2	862.2	570.3
5.0	Sail	26-40	158	7,890	.10	124.7	986.9	4.2		
5.0	Aux Sail	26-40	543	20,090	.075	818.2	1,805.1	4.2		
5.0	House/Pontoon	40-64	10	25,500	.10	25.5	1,830.6	4.2		
5.0	Other	40-64	0	34,430	.10	0	1,830.6	4.2	1,830.6	569.3
4.0	Sail	16-26	168	3,890	.10	65.4	1,895.9	3.2		
4.0	Aux Sail	16-26	612	9,500	.075	436.1	2,332.0	3.2		
4.0	Cruiser	26-40	2,191	24,340	.075	4,000.0	6,331.6	3.2		
4.0	House/Pontoon	26-40	49	15,500	.10	76.0	6,407.6	3.2		
4.0	Other	26-40	10	13,870	.10	13.9	6,421.5	3.2		
3.5	Cruiser	16-26	1,313	7,770	.075	765.2	7,186.7	3.2	7,186.7	568.3
3.0	Cruiser	<16	0	5,200	.075	0	7,186.7	2.2		
3.0	House/Pontoon	16-26	10	3,500	.10	3.5	7,190.1	2.2		
3.0	Other	16-26	10	6,050	.10	6.1	7,196.2	2.2		
3.0	In/Out	26-40	79	10,530	.125	104.0	7,300.1	2.2		
3.0	Inboard	26-40	39	13,530	.10	52.8	7,352.9	2.2		
2.5	Sail	<16	20	880	.10	1.8	7,354.7	2.2		
2.5	Aux Sail	<16	10	1,280	.075	1.0	7,355.6	2.2		
2.5	In/Out	16-26	1,234	6,180	.125	953.3	8,308.9	2.2		
2.5	Inboard	16-26	247	8,300	.10	205.0	8,513.9	2.2		
2.5	Outboard	40-64	20	6,200	.125	15.5	8,529.4	2.2	8,529.4	567.3
2.0	Inboard	<16	0	5,200	.10	0	8,529.4	1.2		
2.0	Other	<16	0	2,920	.10	0	8,529.4	1.2		
2.0	Outboard	26-40	0	5,200	.125	0	8,529.4	1.2		
1.5	Outboard	<16	197	1,160	.125	28.6	8,558.0	1.2		
1.5	In/Out	<16	69	3,800	.125	32.8	8,590.8	1.2		
1.5	Outboard	16-26	454	3,180	.125	180.5	8,771.2	1.2	8,771.2	566.3

1/ Cumulative totals may not add due to rounding.

Table 7a - Stage Damage Computation, Reach 3004

WATERWAY Lake Erie
REACH 3004
AVERAGE DEPTH 8.5
ZERO REFERENCE WATER LEVEL 571.3

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	11	12,890	.10	14.2	14.2	5.5		
6.0	Aux Sail	40-64	11	58,040	.075	47.9	62.1	5.5		
6.0	Cruiser	>64	11	250,000	.075	206.3	268.3	5.5		
6.0	Other	>64	0	150,000	.10	0	268.3	5.5		
5.5	Cruiser	40-64	22	69,500	.075	114.7	383.0	5.5	383.0	568.3
5.0	Sail	26-40	189	7,890	.10	149.1	532.1	4.5		
5.0	Aux Sail	26-40	155	20,090	.075	233.5	765.7	4.5		
5.0	House/Pontoon	40-64	11	25,500	.10	28.1	793.7	4.5		
5.0	Other	40-64	0	34,430	.10	0	793.7	4.5	793.7	567.3
4.0	Sail	16-26	67	3,890	.10	26.1	819.8	3.5		
4.0	Aux Sail	16-26	277	9,500	.075	197.4	1,017.1	3.5		
4.0	Cruiser	26-40	499	24,340	.075	910.9	1,928.1	3.5		
4.0	House/Pontoon	26-40	11	15,500	.10	17.1	1,945.1	3.5		
4.0	Other	26-40	0	13,870	.10	0	1,945.1	3.5		
3.5	Cruiser	16-26	189	7,770	.075	110.1	2,055.2	3.5	2,055.2	566.3
3.0	Cruiser	<16	0	5,200	.075	0	2,055.2	2.5		
3.0	House/Pontoon	16-26	11	3,500	.10	3.9	2,059.1	2.5		
3.0	Other	16-26	0	6,050	.10	0	2,059.1	2.5		
3.0	In/Out	26-40	11	10,530	.125	14.5	2,073.6	2.5		
3.0	Inboard	26-40	0	13,530	.10	0	2,073.6	2.5		
2.5	Sail	<16	0	880	.10	0	2,073.6	2.5		
2.5	Aux Sail	<16	11	1,280	.075	1.1	2,074.6	2.5		
2.5	In/Out	16-26	255	6,180	.125	197	2,271.6	2.5		
2.5	Inboard	16-26	155	8,300	.10	128.7	2,400.3	2.5		
2.5	Outboard	40-64	0	6,200	.125	0	2,400.3	2.5	2,400.3	565.3
2.0	Inboard	<16	22	5,200	.10	11.4	2,411.7	1.5		
2.0	Other	<16	0	2,920	.10	0	2,411.7	1.5		
2.0	Outboard	26-40	0	5,200	.125	0	2,411.7	1.5		
1.5	Outboard	<16	255	1,160	.125	37	2,448.7	1.5		
1.5	In/Out	<16	22	3,800	.125	10.5	2,459.1	1.5		
1.5	Outboard	16-26	333	3,180	.125	132.4	2,591.5	1.5	2,591.5	564.3

1/ Cumulative totals may not add due to rounding.

Table 7b - Stage Damage Computation, Reach 3004

WATERWAY Lake Erie
REACH 3004
AVERAGE DEPTH 6.7
ZERO REFERENCE WATER LEVEL 571.3

BERTH/SLIP
MOORING X

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.7		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	5.7		
6.0	Cruiser	>64	0	250,000	.075	0	0	5.7		
6.0	Other	>64	0	150,000	.10	0	0	5.7	0	570.3
5.5	Cruiser	40-64	0	69,500	.075	0	0	4.7		
5.0	Sail	26-40	21	7,890	.10	16.6	16.6	4.7		
5.0	Aux Sail	26-40	42	20,090	.075	63.3	79.9	4.7		
5.0	House/Pontoon	40-64	0	25,500	.10	0	79.9	4.7		
5.0	Other	40-64	0	34,430	.10	0	79.9	4.7	79.9	569.3
4.0	Sail	16-26	10	3,890	.10	3.9	83.7	3.7		
4.0	Aux Sail	16-26	10	9,500	.075	7.1	90.9	3.7		
4.0	Cruiser	26-40	10	24,340	.075	18.3	109.1	3.7		
4.0	House/Pontoon	26-40	0	15,500	.10	0	109.1	3.7		
4.0	Other	26-40	0	13,870	.10	0	109.1	3.7	109.1	568.3
3.5	Cruiser	16-26	10	7,770	.075	5.8	115.0	2.7		
3.0	Cruiser	<16	0	5,200	.075	0	115.0	2.7		
3.0	House/Pontoon	16-26	0	3,500	.10	0	115.0	2.7		
3.0	Other	16-26	0	6,050	.10	0	115.0	2.7		
3.0	In/Out	26-40	0	10,530	.125	0	115.0	2.7		
3.0	Inboard	26-40	0	13,530	.10	0	115.0	2.7	115.0	567.3
2.5	Sail	<16	0	880	.10	0	115.0	1.7		
2.5	Aux Sail	<16	0	1,280	.075	0	115.0	1.7		
2.5	In/Out	16-26	10	6,180	.125	7.7	122.7	1.7		
2.5	Inboard	16-26	10	8,300	.10	8.3	131.0	1.7		
2.5	Outboard	40-64	0	6,200	.125	0	131.0	1.7		
2.0	Inboard	<16	0	5,200	.10	0	131.0	1.7		
2.0	Other	<16	0	2,920	.10	0	131.0	1.7		
2.0	Outboard	26-40	0	5,200	.125	0	131.0	1.7	131.0	566.3
1.5	Outboard	<16	10	1,160	.125	1.5	132.4	.7		
1.5	In/Out	<16	0	3,800	.125	0	132.4	.7		
1.5	Outboard	16-26	0	3,180	.125	0	132.4	.7	132.4	565.3

1/ Cumulative totals may not add due to rounding.

Table 7c - Stage Damage Curve, Reach 3004

Water Level	Damage ($000) 1980		
	Berth/Slip	Mooring	Totals
569.3	0	79.9	79.9
568.3	383.0	109.1	492.1
567.3	793.7	115.0	908.7
566.3	2,055.2	131.0	2,186.2
565.3	2,400.3	132.4	2,532.7
564.3	2,591.5	132.4	2,723.9

Table 8 - Stage Damage Computation, Reach R004

WATERWAY Niagara River (Upper)
REACH R004
AVERAGE DEPTH 6.0
ZERO REFERENCE WATER LEVEL 563.9

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	6.0		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	6.0		
6.0	Cruiser	>64	0	250,000	.075	0	0	6.0		
6.0	Other	>64	0	150,000	.10	0	0	6.0	0	563.9
5.5	Cruiser	40-64	11	69,500	.075	57.3	57.3	5.0		
5.0	Sail	26-40	11	7,890	.10	8.7	66.1	5.0		
5.0	Aux Sail	26-40	11	20,090	.075	16.6	82.6	5.0		
5.0	House/Pontoon	40-64	0	25,500	.10	0	82.6	5.0		
5.0	Other	40-64	0	34,430	.10	0	82.6	5.0	82.6	562.9
4.0	Sail	16-26	54	3,890	.10	21.0	103.6	4.0		
4.0	Aux Sail	16-26	32	9,500	.075	22.8	126.4	4.0		
4.0	Cruiser	26-40	476	24,340	.075	868.9	995.3	4.0		
4.0	House/Pontoon	26-40	43	15,500	.10	66.7	1,062.0	4.0		
4.0	Other	26-40	11	13,870	.10	15.3	1,077.2	4.0	1,077.2	561.9
3.5	Cruiser	16-26	346	7,770	.075	201.6	1,278.9	3.0		
3.0	Cruiser	<16	0	5,200	.075	0	1,278.9	3.0		
3.0	House/Pontoon	16-26	0	3,500	.10	0	1,278.9	3.0		
3.0	Other	16-26	0	6,050	.10	0	1,278.9	3.0		
3.0	In/Out	26-40	54	10,530	.125	71.1	1,350.0	3.0		
3.0	Inboard	26-40	0	13,530	.10	0	1,350.0	3.0	1,350.0	560.9
2.5	Sail	<16	0	880	.10	0	1,350.0	2.0		
2.5	Aux Sail	<16	0	1,280	.075	0	1,350.0	2.0		
2.5	In/Out	16-26	498	6,180	.125	384.7	1,734.7	2.0		
2.5	Inboard	16-26	54	8,300	.10	44.8	1,779.5	2.0		
2.5	Outboard	40-64	0	6,200	.125	0	1,779.5	2.0		
2.0	Inboard	<16	0	5,200	.10	0	1,779.5	2.0		
2.0	Other	<16	11	2,920	.10	3.2	1,782.7	2.0		
2.0	Outboard	26-40	0	5,200	.125	0	1,782.7	2.0	1,782.7	559.9
1.5	Outboard	<16	76	1,160	.125	11.0	1,793.7	1.0		
1.5	In/Out	<16	0	3,800	.125	0	1,793.7	1.0		
1.5	Outboard	16-26	335	3,180	.125	133.2	1,926.9	1.0	1,926.9	558.9

1/ Cumulative totals may not add due to rounding.

Table 9 - Stage Damage Computation, Reach R005

WATERWAY Niagara River (Lower)
REACH R005
AVERAGE DEPTH 7.0
ZERO REFERENCE WATER LEVEL 245.5

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value[1] ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	6.0		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	6.0		
6.0	Cruiser	>64	0	250,000	.075	0	0	6.0		
6.0	Other	>64	0	150,000	.10	0	0	6.0	0	244.5
5.5	Cruiser	40-64	0	69,500	.075	0	0	5.0		
5.0	Sail	26-40	0	7,890	.10	0	0	5.0		
5.0	Aux Sail	26-40	0	20,090	.075	0	0	5.0		
5.0	House/Pontoon	40-64	0	25,500	.10	0	0	5.0		
5.0	Other	40-64	0	34,430	.10	0	0	5.0	0	243.5
4.0	Sail	16-26	0	3,890	.10	0	0	4.0		
4.0	Aux Sail	16-26	0	9,500	.075	0	0	4.0		
4.0	Cruiser	26-40	67	24,340	.075	122.3	122.3	4.0		
4.0	House/Pontoon	26-40	0	15,500	.10	0	122.3	4.0		
4.0	Other	26-40	0	13,870	.10	0	122.3	4.0	122.3	242.5
3.5	Cruiser	16-26	50	7,770	.075	29.1	151.4	3.0		
3.0	Cruiser	<16	0	5,200	.075	0	151.4	3.0		
3.0	House/Pontoon	16-26	0	3,500	.10	0	151.4	3.0		
3.0	Other	16-26	0	6,050	.10	0	151.4	3.0		
3.0	In/Out	26-40	0	10,530	.125	0	151.4	3.0		
3.0	Inboard	26-40	0	13,530	.10	0	151.4	3.0	151.4	241.5
2.5	Sail	<16	0	880	.10	0	151.4	2.0		
2.5	Aux Sail	<16	0	1,280	.075	0	151.4	2.0		
2.5	In/Out	16-26	17	6,180	.125	13.1	164.6	2.0		
2.5	Inboard	16-26	0	8,300	.10	0	164.6	2.0		
2.5	Outboard	40-64	0	6,200	.125	0	164.6	2.0		
2.0	Inboard	<16	0	5,200	.10	0	164.6	2.0		
2.0	Other	<16	0	2,920	.10	0	164.6	2.0		
2.0	Outboard	26-40	0	5,200	.125	0	164.6	2.0	164.6	240.5
1.5	Outboard	<16	0	1,160	.125	0	164.6	1.0		
1.5	In/Out	<16	0	3,800	.125	0	164.6	1.0		
1.5	Outboard	16-26	17	3,180	.125	6.8	171.3	1.0	171.3	239.5

1/ Cumulative totals may not add due to rounding.

There are 225 moored vessels in reach R005. Because the average depth exceeds 25 feet, no impact would result on boating to moored vessels.

Table 10 - Stage Damage Computation, Reach 2001

WATERWAY Lake Ontario
REACH 2001
AVERAGE DEPTH 6.6
ZERO REFERENCE WATER LEVEL 245.5

BERTH/SLIP X
MOORING X

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.6		
6.0	Aux Sail	40-64	11	58,040	.075	47.9	47.9	5.6		
6.0	Cruiser	>64	0	250,000	.075	0	47.9	5.6		
6.0	Other	>64	0	150,000	.10	0	47.9	5.6	47.9	244.5
5.5	Cruiser	40-64	0	69,500	.075	0	47.9	4.6		
5.0	Sail	26-40	11	7,890	.10	8.7	56.6	4.6		
5.0	Aux Sail	26-40	331	20,090	.075	498.7	555.3	4.6		
5.0	House/Pontoon	40-64	0	25,500	.10	0	555.3	4.6		
5.0	Other	40-64	0	34,430	.10	0	555.3	4.6	555.3	243.5
4.0	Sail	16-26	21	3,890	.10	8.2	563.5	3.6		
4.0	Aux Sail	16-26	128	9,500	.075	91.2	654.7	3.6		
4.0	Cruiser	26-40	107	24,340	.075	195.3	850.0	3.6		
4.0	House/Pontoon	26-40	11	15,500	.10	17.1	867.0	3.6		
4.0	Other	26-40	0	13,870	.10	0	867.0	3.6	867.0	242.5
3.5	Cruiser	16-26	11	7,770	.075	6.4	873.5	2.6		
3.0	Cruiser	<16	0	5,200	.075	0	873.5	2.6		
3.0	House/Pontoon	16-26	0	3,500	.10	0	873.5	2.6		
3.0	Other	16-26	0	6,050	.10	0	873.5	2.6		
3.0	In/Out	26-40	0	10,530	.125	0	873.5	2.6		
3.0	Inboard	26-40	0	13,530	.10	0	873.5	2.6	873.5	241.5
2.5	Sail	<16	0	880	.10	0	873.5	1.6		
2.5	Aux Sail	<16	0	1,280	.075	0	873.5	1.6		
2.5	In/Out	16-26	43	6,180	.125	33.2	906.7	1.6		
2.5	Inboard	16-26	0	8,300	.10	0	906.7	1.6		
2.5	Outboard	40-64	0	6,200	.125	0	906.7	1.6		
2.0	Inboard	<16	0	5,200	.10	0	906.7	1.6		
2.0	Other	<16	0	2,920	.10	0	906.7	1.6		
2.0	Outboard	26-40	0	5,200	.125	0	906.7	1.6	906.7	240.5
1.5	Outboard	<16	160	1,160	.125	23.2	929.9	.6		
1.5	In/Out	<16	0	3,800	.125	0	929.9	.6		
1.5	Outboard	16-26	21	3,180	.125	8.4	938.2	.6	938.2	239.5

1/ Three moored aux sail 16'-26' are in reach 2001. The average mooring depth for this reach is 11.7 feet. Damages are not included in the analysis since impacts would not occur until the water level is as low as 237.5.

Table 11 - Stage Damage Computation, Reach 2002

WATERWAY Lake Ontario
REACH 2002
AVERAGE DEPTH 4.2
ZERO REFERENCE WATER LEVEL 245.5

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.2		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	5.2		
6.0	Cruiser	>64	0	250,000	.075	0	0	5.2		
6.0	Other	>64	0	150,000	.10	0	0	5.2		
5.5	Cruiser	40-64	0	69,500	.075	0	0	5.2	0	246.5
5.0	Sail	26-40	0	7,890	.10	0	0	4.2		
5.0	Aux Sail	26-40	83	20,090	.075	125.1	125.1	4.2		
5.0	House/Pontoon	40-64	0	25,500	.10	0	125.1	4.2		
5.0	Other	40-64	0	34,430	.10	0	125.1	4.2	125.1	245.5
4.0	Sail	16-26	12	3,890	.10	4.7	129.7	3.2		
4.0	Aux Sail	16-26	106	9,500	.075	75.5	205.3	3.2		
4.0	Cruiser	26-40	24	24,340	.075	43.8	249.1	3.2		
4.0	House/Pontoon	26-40	47	15,500	.10	72.9	321.9	3.2		
4.0	Other	26-40	0	13,870	.10	0	321.9	3.2		
3.5	Cruiser	16-26	0	7,770	.075	0	321.9	3.2	321.9	244.5
3.0	Cruiser	<16	0	5,200	.075	0	321.9	2.2		
3.0	House/Pontoon	16-26	0	3,500	.10	0	321.9	2.2		
3.0	Other	16-26	24	6,050	.10	14.5	336.4	2.2		
3.0	In/Out	26-40	12	10,530	.125	15.8	352.2	2.2		
3.0	Inboard	26-40	0	13,530	.10	0	352.2	2.2		
2.5	Sail	<16	0	880	.10	0	352.2	2.2		
2.5	Aux Sail	<16	0	1,280	.075	0	352.2	2.2		
2.5	In/Out	16-26	283	6,180	.125	218.6	570.8	2.2		
2.5	Inboard	16-26	0	8,300	.10	0	570.8	2.2		
2.5	Outboard	40-64	0	6,200	.125	0	570.8	2.2	570.8	243.5
2.0	Inboard	<16	0	5,200	.10	0	570.8	1.2		
2.0	Other	<16	12	2,920	.10	3.5	574.4	1.2		
2.0	Outboard	26-40	0	5,200	.125	0	574.4	1.2		
1.5	Outboard	<16	35	1,160	.125	5.1	579.4	1.2		
1.5	In/Out	<16	12	3,800	.125	5.7	585.1	1.2		
1.5	Outboard	16-26	94	3,180	.125	37.4	622.5	1.2	622.5	242.5

1/ Cumulative totals may not add due to rounding.

Table 12 - Stage Damage Computation, Reach 2003

WATERWAY Lake Ontario
REACH 2003
AVERAGE DEPTH 6.2
ZERO REFERENCE WATER LEVEL 245.5

BERTH/SLIP X
MOORING X

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value[1] ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.2		
6.0	Aux Sail	40-64	11	58,040	.075	47.9	47.9	5.2		
6.0	Cruiser	>64	0	250,000	.075	0	47.9	5.2		
6.0	Other	>64	0	150,000	.10	0	47.9	5.2		
5.5	Cruiser	40-64	11	69,500	.075	57.3	105.2	5.2	105.2	244.5
5.0	Sail	26-40	0	7,890	.10	0	105.2	4.2		
5.0	Aux Sail	26-40	502	20,090	.075	756.4	861.6	4.2		
5.0	House/Pontoon	40-64	0	25,500	.10	0	861.6	4.2		
5.0	Other	40-64	0	34,430	.10	0	861.6	4.2	861.6	243.5
4.0	Sail	16-26	11	3,890	.10	4.3	865.9	3.2		
4.0	Aux Sail	16-26	363	9,500	.075	258.6	1,124.5	3.2		
4.0	Cruiser	26-40	374	24,340	.075	682.7	1,807.3	3.2		
4.0	House/Pontoon	26-40	0	15,500	.10	0	1,807.3	3.2		
4.0	Other	26-40	0	13,870	.10	0	1,807.3	3.2		
3.5	Cruiser	16-26	128	7,770	.075	74.6	1,881.9	3.2	1,881.9	242.5
3.0	Cruiser	<16	0	5,200	.075	0	1,881.9	2.2		
3.0	House/Pontoon	16-26	11	3,500	.10	3.9	1,885.7	2.2		
3.0	Other	16-26	0	6,050	.10	0	1,885.7	2.2		
3.0	In/Out	26-40	21	10,530	.125	27.6	1,913.3	2.2		
3.0	Inboard	26-40	0	13,530	.10	0	1,913.3	2.2		
2.5	Sail	<16	21	880	.10	1.8	1,915.2	1.2	1,915.2	241.5
2.5	Aux Sail	<16	32	1,280	.075	3.1	1,918.3	1.2		
2.5	In/Out	16-26	342	6,180	.125	264.2	2,182.5	1.2		
2.5	Inboard	16-26	11	8,300	.10	9.1	2,191.6	1.2		
2.5	Outboard	40-64	0	6,200	.125	0	2,191.6	1.2		
2.0	Inboard	<16	0	5,200	.10	0	2,191.6	1.2		
2.0	Other	<16	11	2,920	.10	3.2	2,194.8	1.2		
2.0	Outboard	26-40	0	5,200	.125	0	2,194.8	1.2		
1.5	Outboard	<16	192	1,160	.125	27.8	2,222.6	1.2	2,260.3[2]	240.5
1.5	In/Out	<16	21	3,800	.125	10.0	2,232.6	.2		
1.5	Outboard	16-26	117	3,180	.125	46.5	2,279.1	.2	2,375.2[3]	239.5

1/ Cumulative totals may not add due to rounding.

2/ 25 aux. sail (26'-40') with ave. 5' draft are moored in reach 2003 (ave mooring depth is 9.3') and are included in berth/slip calculations (25 x $20,090 x .075 = $37,700). Damages to these vessels are at 240.5 IGLD.

3/ 82 aux. sail (16'-26') with ave. 4' draft are moored in reach 2003 (82 x $9,500 x .075 = $58,400), therefore, total moored vessels sustain damages of $96,100 at 239.5 IGLD.

Table 13 - Stage Damage Computation, Reach 2004

WATERWAY Lake Ontario
REACH 2004
AVERAGE DEPTH 6.1
ZERO REFERENCE WATER LEVEL 245.5

BERTH/SLIP X
MOORING

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value 1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.1		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	5.1		
6.0	Cruiser	>64	0	250,000	.075	0	0	5.1		
6.0	Other	>64	0	150,000	.10	0	0	5.1		
5.5	Cruiser	40-64	0	69,500	.075	0	0	5.1	0	244.5
5.0	Sail	26-40	0	7,890	.10	0	0	4.1		
5.0	Aux Sail	26-40	0	20,090	.075	0	0	4.1		
5.0	House/Pontoon	40-64	0	25,500	.10	0	0	4.1		
5.0	Other	40-64	0	34,430	.10	0	0	4.1	0	243.5
4.0	Sail	16-26	0	3,890	.10	0	0	3.1		
4.0	Aux Sail	16-26	0	9,500	.075	0	0	3.1		
4.0	Cruiser	26-40	0	24,340	.075	0	0	3.1		
4.0	House/Pontoon	26-40	0	15,500	.10	0	0	3.1		
4.0	Other	26-40	0	13,870	.10	0	0	3.1		
3.5	Cruiser	16-26	8	7,770	.075	4.7	4.7	3.1	4.7	242.5
3.0	Cruiser	<16	0	5,200	.075	0	4.7	2.1		
3.0	House/Pontoon	16-26	0	3,500	.10	0	4.7	2.1		
3.0	Other	16-26	0	6,050	.10	0	4.7	2.1		
3.0	In/Out	26-40	0	10,530	.125	0	4.7	2.1		
3.0	Inboard	26-40	0	13,530	.10	0	4.7	2.1		
2.5	Sail	<16	0	880	.10	0	4.7	2.1		
2.5	Aux Sail	<16	0	1,280	.075	0	4.7	2.1		
2.5	In/Out	16-26	8	6,180	.125	6.2	10.8	2.1		
2.5	Inboard	16-26	0	8,300	.10	0	10.8	2.1		
2.5	Outboard	40-64	0	6,200	.125	0	10.8	2.1	10.8	241.5
2.0	Inboard	<16	0	5,200	.10	0	10.8	1.1		
2.0	Other	<16	0	2,920	.10	0	10.8	1.1		
2.0	Outboard	26-40	0	5,200	.125	0	10.8	1.1		
1.5	Outboard	<16	8	1,160	.125	1.2	12.0	1.1		
1.5	In/Out	<16	0	3,800	.125	0	12.0	1.1		
1.5	Outboard	16-26	8	3,180	.125	3.2	15.2	1.1	15.2	240.5

1/ Cumulative totals may not add due to rounding.

Table 14 - Stage Damage Computation, Reach 2005

WATERWAY Lake Ontario
REACH 2005
AVERAGE DEPTH 5.1
ZERO REFERENCE WATER LEVEL 245.5

BERTH/SLIP X
MOORING X

Required Draft	Class	Length (feet)	Number	Depreciated Value 1980 $	Rate of Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.1		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	5.1		
6.0	Cruiser	>64	0	250,000	.075	0	0	5.1		
6.0	Other	>64	0	150,000	.10	0	0	5.1		
5.5	Cruiser	40-64	0	69,500	.075	0	0	5.1	0	245.5
5.0	Sail	26-40	0	7,890	.10	0	0	4.1		
5.0	Aux Sail	26-40	132	20,090	.075	198.9	198.9	4.1		
5.0	House/Pontoon	40-64	20	25,500	.10	51.0	249.9	4.1		
5.0	Other	40-64	0	34,430	.10	0	249.9	4.1	249.9	244.5
4.0	Sail	16-26	0	3,890	.10	0	249.9	3.1		
4.0	Aux Sail	16-26	92	9,500	.075	65.6	315.4	3.1		
4.0	Cruiser	26-40	306	24,340	.075	558.6	874.0	3.1		
4.0	House/Pontoon	26-40	41	15,500	.10	63.6	937.6	3.1		
4.0	Other	26-40	10	13,870	.10	13.9	951.5	3.1		
3.5	Cruiser	16-26	214	7,770	.075	124.7	1,076.2	3.1	1,076.2	243.5
3.0	Cruiser	<16	0	5,200	.075	0	1,076.2	2.1		
3.0	House/Pontoon	16-26	0	3,500	.10	0	1,076.2	2.1		
3.0	Other	16-26	0	6,050	.10	0	1,076.2	2.1		
3.0	In/Out	26-40	20	10,530	.125	26.3	1,102.5	2.1		
3.0	Inboard	26-40	31	13,530	.10	41.9	1,144.4	2.1		
2.5	Sail	<16	0	880	.10	0	1,144.4	2.1		
2.5	Aux Sail	<16	0	1,280	.075	0	1,144.4	2.1		
2.5	In/Out	16-26	642	6,180	.125	495.9	1,640.4	2.1		
2.5	Inboard	16-26	163	8,300	.10	135.3	1,775.7	2.1		
2.5	Outboard	40-64	0	6,200	.125	0	1,775.7	2.1	1,775.7	242.5
2.0	Inboard	<16	0	5,200	.10	0	1,775.7	1.1		
2.0	Other	<16	71	2,920	.10	20.7	1,796.4	1.1		
2.0	Outboard	26-40	0	5,200	.125	0	1,796.4	1.1		
1.5	Outboard	<16	295	1,160	.125	42.8	1,839.2	1.		
1.5	In/Out	<16	112	3,800	.125	53.2	1,892.4	1.1		
1.5	Outboard	16-26	316	3,180	.125	125.6	2,018.0	1.1	2,018.0	241.5

1/ Cumulative totals may not add due to rounding.

There are an additional 116 aux. sail (48 - 26'-40', with 5' draft; 68 - 16'-26', with 4' draft) in reach 2005. The ave. mooring depth is 9.8'. Therefore, at 240.5 IGLD, damages are $2,090,300 (48 x $20,090 x .075 = $72,300 + $2,018,000). At 239.5 IGLD, damages are $2,138,800 (68 x $9,500 x .075 = $48,500 + 2,090,300).

Table 15 - Stage Damage Computation, Reach R006

WATERWAY St. Lawrence River
REACH R006
AVERAGE DEPTH 5.3
ZERO REFERENCE WATER LEVEL 244.9

BERTH/SLIP X
MOORING

Required: Draft	Class	Length (feet)	Number	Depreciated: Value 1980 $	Rate of: Return	Total Return 1980 ($000)	Cumulative Return Value1/ ($000)	Available: Depth	Damage (1980) ($000)	Water Level (IGLD)
6.0	Sail	40-64	0	12,890	.10	0	0	5.3		
6.0	Aux Sail	40-64	0	58,040	.075	0	0	5.3		
6.0	Cruiser	>64	0	250,000	.075	0	0	5.3		
6.0	Other	>64	0	150,000	.10	0	0	5.3		
5.5	Cruiser	40-64	60	69,500	.075	312.8	312.8	5.3	312.8	244.9
5.0	Sail	26-40	0	7,890	.10	0	312.8	4.3		
5.0	Aux Sail	26-40	0	20,090	.075	0	312.8	4.3		
5.0	House/Pontoon	40-64	12	25,500	.10	30.6	343.4	4.3		
5.0	Other	40-64	12	34,430	.10	41.3	384.7	4.3	384.7	243.9
4.0	Sail	16-26	0	3,890	.10	0	384.7	3.3		
4.0	Aux Sail	16-26	12	9,500	.075	8.6	393.2	3.3		
4.0	Cruiser	26-40	203	24,340	.075	370.6	763.8	3.3		
4.0	House/Pontoon	26-40	24	15,500	.10	37.2	801.0	3.3		
4.0	Other	26-40	0	13,870	.10	0	801.0	3.3		
3.5	Cruiser	16-26	143	7,770	.075	83.3	884.3	3.3	884.3	242.9
3.0	Cruiser	<16	0	5,200	.075	0	884.3	2.3		
3.0	House/Pontoon	16-26	24	3,500	.10	8.4	892.7	2.3		
3.0	Other	16-26	0	6,050	.10	0	892.7	2.3		
3.0	In/Out	26-40	0	10,530	.125	0	892.7	2.3		
3.0	Inboard	26-40	0	13,530	.10	0	892.7	2.3		
2.5	Sail	<16	0	880	.10	0	892.7	2.3		
2.5	Aux Sail	<16	0	1,280	.075	0	892.7	2.3		
2.5	In/Out	16-26	191	6,180	.125	147.5	1,040.3	2.3		
2.5	Inboard	16-26	96	8,300	.10	79.7	1,120.0	2.3		
2.5	Outboard	40-64	0	6,200	.125	0	1,120.0	2.3	1,120.0	241.9
2.0	Inboard	<16	0	5,200	.10	0	1,120.0	1.3		
2.0	Other	<16	0	2,920	.10	0	1,120.0	1.3		
2.0	Outboard	26-40	0	5,200	.125	0	1,120.0	1.3		
1.5	Outboard	<16	191	1,160	.125	27.7	1,147.6	1.3		
1.5	In/Out	<16	12	3,800	.125	5.7	1,153.3	1.3		
1.5	Outboard	16-26	191	3,180	.125	75.9	1,229.3	1.3	1,229.3	240.9

1/ Cumulative totals may not add due to rounding.

Annex N - Stage-Duration Data

Table 1 - Stage Duration Data by Plan and Reach
Category 2
R006 St. Lawrence (Ogdensburg)

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	242.6	100.0	243.3	100.0	243.4	100.0	243.4
99.7	243.1	99.7	243.4	99.0	243.5	99.5	243.5
98.4	243.3	98.2	243.6	97.1	243.7	97.1	243.7
97.7	243.6	95.8	243.8	94.8	243.8	87.0	244.1
95.3	243.7	93.2	243.8	92.2	243.9	79.7	244.3
90.1	243.9	83.1	244.2	87.0	244.1	72.2	244.4
62.6	244.6	18.4	245.2	85.2	244.2	66.5	244.6
34.0	245.0	15.6	245.3	62.3	244.7	33.2	245.0
31.2	245.0	13.0	245.3	43.9	244.9	30.4	245.1
26.0	245.1	10.6	245.4	41.3	244.9	24.4	245.1
23.4	245.1	8.1	245.6	26.5	245.1	20.3	245.2
19.2	245.2	5.5	245.7	23.6	245.2	18.2	245.3
10.9	245.4	3.1	245.9	18.4	245.3	13.0	245.4
5.7	245.6	1.3	246.1	10.6	245.5	8.3	245.6
2.9	245.7	.3	246.3	8.3	245.7	5.5	245.7
1.3	245.9			3.6	246.0	3.1	245.9
.3	246.2			1.6	246.2	1.3	246.1
				.3	246.4	.3	246.4

Table 2 - Stage Duration Data by Plan and Reach
Category 2
2005-2001 Lake Ontario and R005 Lower Niagara

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	243.6	100.0	243.7	100.0	243.8	100.0	243.8
99.7	243.7	98.7	244.2	99.5	244.1	99.5	244.0
99.5	244.0	96.9	244.4	95.6	244.5	99.0	244.2
98.2	244.1	94.5	244.5	91.2	244.7	94.5	244.5
96.9	244.3	67.8	245.2	79.0	245.0	87.0	244.8
91.7	244.6	65.5	245.2	76.4	245.0	66.5	245.2
84.7	244.7	62.9	245.3	65.7	245.2	63.9	245.2
82.6	244.8	34.5	245.6	62.9	245.3	17.1	245.9
14.8	246.0	31.7	245.7	54.5	245.4	14.8	246.0
9.9	246.2	19.2	245.9	52.2	245.4	11.9	246.1
7.5	246.3	8.6	246.2	25.7	245.8	9.4	246.2
2.9	246.6	3.9	246.5	10.6	246.2	7.0	246.4
1.3	246.9	3.4	246.7	8.3	246.4	4.7	246.5
.5	247.2	2.3	246.9	5.7	246.5	1.0	247.1
.3	247.4	1.0	247.1	4.4	246.8	.3	247.4
		.3	247.3	2.3	247.0		
				1.0	247.2		
				.3	247.5		

Table 3 - Stage Duration Data by Plan and Reach
R004 Upper Niagara River

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	563.0	100.0	563.0	100.0	563.0	100.0	563.0
99.7	563.1	99.7	563.1	97.9	563.1	99.7	563.1
97.1	563.2	97.1	563.2	95.1	563.2	97.1	563.2
94.3	563.3	94.3	563.3	92.7	563.3	94.3	563.3
91.4	563.3	91.4	563.3	89.9	563.4	88.6	563.4
88.6	563.4	88.8	563.4	82.3	563.5	85.7	563.5
82.9	563.5	81.0	563.6	53.0	563.9	82.9	563.5
65.5	563.8	73.0	563.7	50.1	563.9	66.0	563.7
62.3	563.8	70.4	563.7	48.1	563.9	32.7	564.0
47.8	564.0	53.2	563.9	45.5	564.0	25.5	564.1
38.4	564.0	51.4	563.9	28.8	564.1	22.3	564.2
24.9	564.2	36.9	564.0	17.7	564.4	17.9	564.2
14.3	564.3	22.1	564.2	15.1	564.4	15.6	564.3
8.3	564.5	7.0	564.5	9.9	564.5	7.5	564.4
6.0	564.5	4.4	564.6	7.0	564.5	2.6	564.7
3.6	564.7	2.1	564.7	4.4	564.7	.5	564.9
1.6	564.8	.3	564.9	2.1	564.8		
.3	565.0			.3	565.0		

Table 4 - Stage Duration Data by Plan and Reach
3004-3001 Lake Erie

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	569.0	100.0	569.0	100.0	568.8	100.0	569.0
98.7	569.3	99.2	569.2	99.0	569.0	98.7	569.2
94.3	569.6	94.8	569.6	97.1	569.2	96.6	569.4
91.7	569.8	89.6	569.8	94.8	569.4	94.5	569.6
84.7	570.2	85.2	570.2	87.3	569.7	91.9	569.7
30.9	571.7	82.6	570.3	84.4	569.8	87.5	570.0
28.1	571.7	46.5	571.2	81.8	569.9	84.9	570.1
26.0	571.8	43.4	571.3	69.1	570.3	82.6	570.2
21.3	571.9	21.0	571.8	60.5	570.4	80.3	570.3
16.1	572.2	15.6	572.1	57.7	570.5	71.9	570.4
13.5	572.2	13.0	572.1	51.7	570.5	67.5	570.6
10.9	572.3	8.3	572.3	50.1	570.6	10.6	572.0
6.2	572.6	6.2	572.5	8.3	571.6	8.1	572.1
4.7	572.9	4.7	572.7	6.0	571.7	6.2	572.3
2.6	573.1	2.6	572.9	4.4	571.9	4.2	572.5
.3	573.6	1.3	573.2	2.9	572.1	2.6	572.8
		.3	573.5	1.6	572.3	1.3	572.9
				.3	572.5	.3	573.2

Table 5 - Stage Duration Data by Plan and Reach
R003 Detroit River

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	571.0	100.0	571.0	100.0	571.0	100.0	571.0
99.7	571.2	99.7	571.2	99.7	571.1	99.7	571.2
98.7	571.4	98.7	571.4	98.7	571.3	98.7	571.3
89.9	571.8	96.1	571.5	93.5	571.5	96.1	571.5
88.1	572.0	93.8	571.6	90.9	571.6	93.8	571.6
85.7	572.1	88.8	571.9	81.3	572.1	91.2	571.7
83.4	572.3	86.8	572.0	39.2	572.9	88.6	571.8
67.3	572.7	79.7	572.4	36.9	573.0	86.2	572.0
64.7	572.8	46.5	573.2	24.4	573.2	78.7	572.4
52.2	573.2	44.2	573.3	21.8	573.3	25.2	573.5
46.8	573.3	20.5	573.8	19.0	573.4	15.8	573.8
44.4	573.4	8.1	574.3	10.6	573.6	13.8	573.9
20.8	573.8	6.8	574.5	8.1	573.7	8.8	574.0
11.4	574.2	4.9	574.7	6.5	573.9	1.6	574.9
9.1	574.3	3.4	574.9	4.4	574.0	.3	575.1
1.6	575.2	1.6	575.0	3.4	574.2		
.3	575.4	.3	575.3	1.6	574.3		
				.3	574.6		

Table 6 - Stage Duration Data by Plan and Reach
R002 Lake St. Clair

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	571.8	100.0	571.8	100.0	571.7	100.0	571.7
99.2	572.0	99.5	572.0	99.2	572.0	99.7	571.9
97.1	572.2	97.7	572.2	97.1	572.2	98.2	572.1
94.8	572.4	95.3	572.3	94.5	572.3	90.6	572.5
92.5	572.5	92.7	572.4	91.7	572.4	88.6	572.7
90.4	572.6	90.4	572.6	89.1	572.5	78.7	573.2
88.3	572.8	88.3	572.8	87.0	572.7	60.8	573.7
83.6	573.1	83.6	573.1	84.4	572.8	58.2	573.7
44.9	574.3	81.0	573.1	82.1	572.9	50.4	574.0
36.4	574.5	78.4	573.3	76.9	573.1	47.8	574.0
33.5	574.5	36.1	574.4	27.5	574.2	45.2	574.1
23.6	574.7	33.0	574.5	24.7	574.3	31.7	574.4
10.6	575.2	24.9	574.6	19.2	574.3	28.8	574.4
8.3	575.4	10.6	575.1	12.2	574.5	8.6	575.1
7.3	575.6	8.3	575.3	9.6	574.6	7.3	575.3
5.2	575.8	7.3	575.5	3.6	575.2	3.6	575.7
1.6	576.2	1.6	576.1	1.8	575.4	1.6	575.9
.3	576.4	.3	576.3	.3	575.7	.3	576.1

Table 7 - Stage Duration Data by Plan and Reach
R001 St. Clair River

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	573.7	100.0	573.7	100.0	573.6	100.0	573.7
99.7	573.7	98.4	574.1	97.7	574.1	98.2	574.1
98.7	574.0	96.6	574.3	95.3	574.3	96.1	574.3
97.4	574.2	91.4	574.5	92.5	574.4	90.9	574.5
92.7	574.5	89.4	574.7	84.7	574.8	88.8	574.7
90.6	574.7	79.5	575.2	82.3	574.9	81.0	575.1
88.3	574.8	49.1	576.3	80.0	575.0	79.0	575.2
78.7	575.3	21.6	576.9	77.4	575.1	57.9	575.8
59.2	575.9	18.4	577.0	56.1	575.7	50.4	576.2
51.7	576.2	16.1	577.1	53.5	575.8	20.0	576.8
18.4	577.0	13.5	577.2	50.9	575.9	16.1	576.9
13.2	577.2	10.6	577.3	34.8	576.3	13.5	577.1
10.6	577.3	8.3	577.4	32.7	576.3	10.9	577.1
8.3	577.5	7.5	577.7	17.1	576.7	8.6	577.3
7.3	577.8	5.5	577.9	8.6	576.9	7.8	577.5
5.5	578.0	3.1	578.1	7.5	577.2	3.6	577.9
3.1	578.1	.3	578.5	3.6	577.6	.3	578.4
.3	578.6			.3	578.0		

Table 8 - Stage Duration Data by Plan and Reach
Category 1, Method 2
R006 Ogdensburg

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	242.6	100.0	242.7	100.0	242.8	100.0	242.8
99.7	243.1	99.7	243.1	99.7	243.1	99.5	243.1
98.4	243.3	98.2	243.5	99.5	243.2	99.0	243.4
97.7	243.6	96.4	243.6	98.2	243.4	97.1	243.6
95.3	243.7	88.8	244.0	96.1	243.6	94.8	243.7
90.1	243.9	63.4	244.6	93.8	243.7	92.2	243.8
62.6	244.6	42.6	244.8	91.4	243.8	89.4	243.9
34.0	245.0	39.7	244.9	88.8	243.9	86.8	244.0
31.2	245.0	37.4	244.9	86.0	244.0	84.7	244.1
26.0	245.1	36.6	244.9	82.9	244.1	79.5	244.2
23.4	245.1	23.6	245.1	81.0	244.2	75.1	244.3
19.2	245.2	20.8	245.2	26.0	245.1	9.6	245.4
10.9	245.4	18.2	245.2	17.7	245.2	7.0	245.6
5.7	245.6	12.5	245.3	12.2	245.4	4.7	245.8
2.9	245.7	2.9	245.7	4.9	245.8	2.3	245.9
1.3	245.9	.3	246.2	2.9	246.0	.5	246.1
.3	246.2			2.1	246.2	.3	246.4
				.3	246.4		

Table 9 - Stage Duration Data by Plan and Reach
Category 1, Method 2
2005-2001 Lake Ontario and R005 Lower Niagara

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	243.6	100.0	243.6	100.0	243.3	100.0	243.4
99.7	243.7	99.7	243.8	99.7	243.6	99.7	243.8
99.5	244.0	99.2	244.0	97.4	244.1	97.4	244.2
98.2	244.1	97.9	244.2	95.3	244.2	95.3	244.4
96.9	244.3	96.1	244.4	90.6	244.5	87.3	244.7
91.7	244.6	91.7	244.6	85.5	244.7	72.7	245.0
84.7	244.7	89.1	244.6	70.4	245.0	70.4	245.0
82.6	244.8	86.2	244.7	65.2	245.1	21.8	245.8
14.8	246.0	83.4	244.8	49.1	245.4	19.0	245.9
9.9	246.2	80.5	244.9	44.2	245.5	14.3	246.0
7.5	246.3	19.0	245.9	42.1	245.5	11.9	246.2
2.9	246.6	16.6	245.9	25.5	245.8	9.1	246.2
1.3	246.9	9.4	246.2	16.9	246.0	6.8	246.4
.5	247.2	7.3	246.4	9.1	246.4	4.7	246.6
.3	247.4	4.9	246.5	4.4	246.7	2.3	246.8
		2.6	246.7	1.0	247.1	.8	247.0
		1.0	246.9	.3	247.5	.3	247.6
		.3	247.4				

Table 10 - Stage Duration Data by Plan and Reach
Category 3
R006 St. Lawrence Ogdensburg

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	243.4	100.0	243.4	100.0	243.4	100.0	243.3
99.7	243.4	99.5	243.5	96.4	243.7	99.2	243.4
97.9	243.6	97.7	243.6	91.4	244.0	97.4	243.6
95.3	243.7	95.3	243.8	88.8	244.0	88.1	244.0
92.5	243.8	92.7	243.8	86.2	244.1	77.1	244.3
90.1	243.9	85.2	244.1	70.4	244.5	74.5	244.4
79.5	244.2	80.0	244.2	62.1	244.7	27.8	245.0
66.8	244.5	77.1	244.3	45.2	244.9	27.0	245.0
64.4	244.6	74.5	244.4	36.9	245.0	22.1	245.1
14.8	245.2	71.9	244.4	31.9	245.0	20.0	245.2
12.2	245.3	69.4	244.5	16.6	245.3	12.7	245.3
9.4	245.3	11.2	245.3	14.0	245.4	10.6	245.3
6.8	245.4	8.6	245.4	11.4	245.4	6.0	245.6
4.4	245.5	6.2	245.5	7.0	245.6	3.4	245.7
2.3	245.7	3.6	245.6	4.4	245.7	1.6	245.9
.3	245.9	2.1	245.8	.3	246.1	.3	246.1
		.3	246.1				

Table 11 - Stage Duration Data by Plan and Reach
Category 3
2005-2001 Lake Ontario and R005 Lower Niagara

BOC		SEO 6L		25 N		SEO 15S2	
Frequency	Water Level	Frequency	Water Level	Frequency	Water Level	Frequency	Water Level
100.0	243.7	100.0	243.8	100.0	244.1	100.0	243.8
99.7	244.0	99.7	244.1	97.9	244.4	99.5	244.0
98.7	244.1	98.2	244.3	95.6	244.5	97.9	244.3
97.1	244.4	95.6	244.5	93.0	244.6	95.8	244.4
94.8	244.5	91.4	244.6	90.4	244.7	93.2	244.5
89.4	244.7	88.6	244.7	84.9	244.8	83.9	244.8
86.8	244.7	83.4	244.8	82.9	244.9	78.2	244.9
84.4	244.8	76.1	245.0	70.1	245.1	72.5	245.0
77.9	244.9	59.7	245.2	65.7	245.2	68.8	245.0
75.8	245.0	57.1	245.3	63.6	245.2	48.8	245.4
41.3	245.5	35.8	245.6	24.7	245.8	46.2	245.4
39.2	245.5	31.9	245.6	14.5	246.0	29.1	245.7
33.5	245.6	29.4	245.7	12.2	246.2	23.9	245.8
10.9	246.0	21.8	245.8	[illegible].6	246.2	21.3	245.8
8.3	246.1	13.0	246.0	7.3	246.4	19.2	245.8
3.4	246.4	8.3	246.1	4.7	246.5	8.8	246.1
1.8	246.6	1.8	246.6	2.3	246.7	2.1	246.6
.3	246.8	.3	246.8	.3	246.9	.3	246.9

Annex O - Gravity Demand Model Analysis for Boating Facilities on Lakes Erie and Ontario and Connecting Waterways

GRAVITY DEMAND MODEL ANALYSIS FOR BOATING FACILITIES ON LAKES ERIE AND ONTARIO AND CONNECTING WATERWAYS

1. Overall description of the model: The gravity model was calibrated around the present supply of commercial marina slips in the 17 reaches along Lakes Erie and Ontario and connecting waterways. The inputs include population forecasts, growth in boat registration, distance from market areas to the marina facilities in the reaches, market penetration rates, and moorage capacity in the reaches. The outputs from the model are essentially the potential markets for slippage in each of the 17 reaches for 1985, 1995, 2005, 2015, 2025, and 2035.

Gravity models in general are based on the concept that a specific and measurable relationship exists between the number of visitors arriving at a given destination from specific markets and a series of independent variables. The most important variables usually are: (1) the magnitude (size) of the population in the market area, and (2) the distance between the destination and market. The model typically yields high correlation between distance to populated centers and the number of visits. Correlation with other variables such as income of the population, urbanization, highway quality, and competition from other recreation areas may or may not improve the overall results of the model.

The general formula for the gravity model used in the study is:

$$T_{ij} = \frac{P_i \dfrac{A_j}{d_{ij}^{\,b}}}{\dfrac{A_1}{d_{i1}^{\,b}} + \dfrac{A_2}{d_{i2}^{\,b}} + \cdots + \dfrac{A_n}{d_{in}^{\,b}}}$$

Where T_{ij} is the potential slip market from county i to reach j

P_i is the total slip market produced by county i

A_j is the total slip market attracted by reach j

d_{ij} is the spatial separation of county i and reach j

b is an empirically determined exponent which expresses the average areawide effect of spatial separation between zones on the amount of slip interchange. (This factor was developed from the origin/destination data developed in the 1979 recreation boating survey.)

n is the number of reaches (17)

It may be noted in this equation that four factors are of major importance: trip productions, trip attractions, spatial distance separation, and the number of areas. Of course, the latter two are simply the distance between each county and the 17 reaches, thus forming a matrix of 62 primary market counties by 17 reaches. The trip productions (the market generated by each county) were composed of the following specific variables:

- Population forecasts for 62 counties (1985, 1995, 2005, 2015, 2025, and 2035).

- Boat registration per 1,000 population in 62 counties for 1979 (projected to 1985).

- Growth in boat registration for four states in 1985, 1995, 2005, 2015, 2025, and 2035.

- Market penetration rates for 62 counties, six distance zones, and 6 years (1985, 1995, 2005, 2015, 2025, and 2035).

The population forecasts for the 62 counties were derived from the latest estimates.1/ The 1979 boat registration (and a growth factor of 5 percent) and the forecast population for 1985 were used to derive the boat registration per thousand population for that year. MRI assumed the future boat registration per thousand population would be constant at State levels (1.00); thus, the growth factors in the model are:2/

GROWTH FACTORS (BOAT REGISTRATION)

State	1985	1995	2005	2015	2025	2035
Michigan	1.00	1.00	1.00	1.00	1.00	1.00
Pennsylvania	1.00	1.00	1.00	1.00	1.00	1.00
New York	1.00	1.00	1.00	1.00	1.00	1.00
Ohio	1.00	1.00	1.00	1.00	1.00	1.00

The result of applying the growth factors to the product of population (6 years) and registration in 1985 (the base year) resulted in estimated boat registration in the 62 counties for the 6 years under study.

1/ The county population projections provided by each of the four States incorporate the Census Bureau's latest "Series E" national population and projection and the Bureau of Economic Analysis' industrial and regional disaggregation thereof, as published in The 1972-E OBERS Projections, November 1974.

2/ This corresponds to the growth rate used in the beaches model (a zero participation growth rate).

The market penetration rates presented a much more complex problem. Obviously, a county or population center within a few miles of a lake will provide more potential use of that lake than another market center more distant. Unfortunately, no single study provides data in such specific detail as percentages of the total market by distance zones. Three previous studies were used in developing the market penetration factors. MRI previously conducted a market study at three Corps of Engineers lakes for the Little Rock District. These studies provided the overall percentage of the total market coming from various distances to the three Corps lakes.1/ A previous Corps of Engineers marina market study for Shelbyville Lake in Illinois provided similar types of data for specific counties at varying distances from three marinas. Unfortunately these data were aggregated and a specific breakdown by marina was not possible.2/ MRI also calibrated the gravity model for 28 lock and dam operations (162 primary market counties) on the Mississippi River.3/ The MRI boating survey of Lake Erie/Ontario boaters also provided origin/destination data for 2,043 respondents. Using these sources of information as a general guide, market penetration rates for six distance zones and the 6 years were developed by several gravity model calibration runs. The final market penetration rates used in the model are as follows:

Market Penetration Rates (1985-2035)	Cumulative Percent	Distance Zone
0.1240	71.0	0 to 25 miles
0.0260	14.9	26 to 50 miles
0.0110	6.3	51 to 75 miles
0.0074	4.2	76 to 99 miles
0.0053	3.0	100 to 150 miles
0.0000	0.0	151 miles or greater

The potential market for a particular year was then computed as follows: the population forecast for a given year and county was multiplied by the 1985 boat registration (base year) per thousand population. This product was in turn multiplied by the boat registration growth factor (1.00) for the particular year under study and resulted in the adjusted boat registration for that year. Based on the distance from the primary market county to the particular reach, the potential slip market was estimated. (Note that the total potential slip market for a county is the sum of all 17 reaches.) The net result of using this technique for the entire market area produced the potential slip market that would be generated from the 62 counties for the 6 different years. The rates in the above table applied to 1985 population and

1/ "Market Analysis for Marina Concession Facilities at Greers Ferry, Ozark and Table Rock Lakes," U.S. Army, Corps of Engineers District, Little Rock (1974).

2/ "A Study of the Market Potential for Small Craft Marina Concessions at Lake Shelbyville," U.S. Army, Corps of Engineers District, St. Louis (1975).

3/ "Methodology and Forecasts of Recreation Use and Small Craft Lockages on the Upper Mississippi River," U.S. Army Corps of Engineers District, St. Paul (July 26, 1978).

boat registration estimates provide a potential growth in marina slippage in the primary market area of 5.2 percent over the 1979 slippage. This corresponds roughly to an annual growth rate of 1.0 percent in boat registration.

2. Analysis of the gravity model demand: The model allocated the potential slip market somewhat differently than the present pattern of slippage. Table 1 shows the present slippage capacity and potential slip market for the 17 reaches.

Table 1 - Current Marina Slip Capacity and Future Potential for Selected Great Lake Reaches

Reach	Current Marina Slip Capacity[a]	Potential Slip Market[b] (1985)	Differences
R008	145	146	+1
R007	14	16	+2
R006	1,145	1,136	-9
2005	2,985	2,969	-16
2004	40	38	-2
2003	2,364	2,513	+149
2002	667	707	+40
2001	733	701	-32
R005	361	334	-27
R004	2,268	2,082	-186
3004	2,825	2,769	-56
3003	8,171	6,918	-1,253
3002	13,633	11,090	-2,543
3001	3,152	3,043	-109
R003	4,354	4,236	-118
R002	9,138	9,035	-103
R001	2,157	2,109	-48
Total	54,152	49,842[c]	

[a] MRI Boating Facility Inventory (1979) -- Sum of wet berths/slips and moorings.

[b] Output from the GRAVITY Model (1985).

[c] This compares to the current slip utilization of 47,387 (MRI Boating Facility Inventory), or an increase of 2,455 slips needed (5.2 percent increase by 1985).

In terms of current slip/mooring capacity, essentially all of the 1985 demand could be accommodated at existing boating facilities. Only one reach (2003) shows any large increase (149) over 1979 capacity. This condition is primarily the result of the current occupancy for all 17 reaches (both slips and moorings) being only 87.5 percent. A total of nearly 7,000 slips are currently available for rental in the two lakes and connecting waterways.

Unfortunately, these statistics do not tell the entire story. A total of 26.8 percent of the existing slip/mooring capacity is of either fair or

poor quality (see MRI Technical Report No. 1). Many of these are not of acceptable quality to attract either new boaters or those upgrading their equipment. In addition, many of the available slips/moorings are located in the more shallow parts of marinas and therefore cannot accommodate larger craft.

A truer picture of boating needs may be obtained by comparing potential utilization (the gravity output) to current utilization. If potential utilization in future years is greater than current utilization, this excess over current use may be considered additional slip/mooring needs. Table 2 makes this comparison. It may be noted that, in terms of this definition, all reaches will require additional slips/moorings by 1985 except 3003 and 3002. The reaches requiring the greatest slip/mooring needs by 1985 are 2005 (607), 2003 (386), 3001 (465), R003 (304), R002 (866), and R001 (746). By 2005, all reaches will require additional slips/moorings.

The growth factors for the small boat harbor formula (MRI Technical Report No. 5, Economic Impacts of Lake Level Regulation) were developed by dividing future potential utilization (the gravity output) by existing utilization (e.g., 1985 potential is 146 in R008; existing utilization is 132; 146 ÷ 132 = 1.11). Table 3 shows the growth factors used in the development of economic damages (see Technical Report No. 5).

3. Program flow: The model basically has two component sections. The first section is a subroutine that generates the demand for trip productions; the second portion is the gravity model allocation itself.

a. Demand: Figure 1 shows the overall flow of the model. First, the population input for 62 counties and 6 years (1985, 1995, 2005, 2015, 2025, and 2035) is multiplied by the boat registration per 1,000 population (1979, projected to 1985). This essentially, in terms of the present registration figures, calculates the number of total boats that will be registered for the 5 forecast years. Of course, this assumes that this base year per capita rate is constant. To provide for future growth, these calculated estimates of boat registration are multiplied by State growth factors to develop the adjusted boat registration for future years. This adjusted figure is an interim model output and provides boat registration for the 62 counties and 6 forecast years. In the Lake Erie model, future boat registration per 1,000 population was held constant (a factor of 1.00). This is comparable to the assumption made in the beaches model.

Next, this interim output is multiplied by a combination of the two distance matrices (both mileage and zones) and the market penetration rates to develop the gross slip market for the 62 counties and 6 years. This interim output is then input into the gravity model and allocated using the equation previously described. To provide the user the advantage of examining these numbers both at the county and the resource area level, two interim tables are generated by the model. One is the potential slip market by 62 counties and 6 years, and the second is the potential slip market for the 17 reaches and 6 forecast years. The potential slip market input is the basis for the trip productions (slip/mooring needs) that are allocated to the attractions (17 reaches) using the gravity equation.

Table 2 - Current Slip Utilization and Future Potential for Selected Great Lakes Reaches

Reach	Current Utilization[a]	1985 Potential Utilization[b]	1985 Excess Over Current Use	1995 Potential Utilization[b]	1995 Excess Over Current Use	2005 Potential Utilization[b]	2005 Excess Over Current Use	2015 Potential Utilization[b]	2015 Excess Over Current Use	2025 Potential Utilization[b]	2025 Excess Over Current Use	2035 Potential Utilization[b]	2035 Excess Over Current Use
R008	132	146	14	155	23	164	32	172	40	181	49	190	58
R007	2	16	14	17	15	18	16	19	17	20	18	21	19
R006	1,013	1,136	123	1,207	194	1,278	265	1,349	336	1,419	406	1,490	477
2005	2,362	2,969	607	3,165	803	3,363	1,001	3,560	1,198	3,757	1,395	3,955	1,593
2004	30	38	8	40	10	42	12	45	15	47	17	49	19
2003	2,127	2,513	386	2,700	573	2,886	759	3,070	943	3,252	1,125	3,433	1,306
2002	576	707	131	761	185	815	239	868	292	920	344	972	396
2001	622	701	79	754	132	809	187	865	243	921	299	978	356
R005	296	334	38	355	59	376	80	398	102	419	123	441	145
R004	1,935	2,082	147	2,204	269	2,327	392	2,451	516	2,575	640	2,700	765
3004	2,575	2,769	194	2,945	370	3,121	546	3,297	722	3,472	897	3,647	1,072
3003	7,560	6,918	0	7,332	0	7,746	186	8,158	598	8,570	1,010	8,982	1,422
3002	12,115	11,090	0	11,817	0	12,544	429	13,270	1,155	13,997	1,882	14,724	2,609
3001	2,578	3,043	465	3,240	662	3,438	860	3,635	1,057	3,833	1,255	4,031	1,453
R003	3,932	4,236	304	4,512	580	4,788	856	5,064	1,132	5,340	1,408	5,616	1,684
R002	8,169	9,035	866	9,628	1,459	10,221	2,052	10,815	2,646	11,408	3,239	12,003	3,834
R001	1,363	2,109	746	2,249	886	2,389	1,026	2,530	1,167	2,670	1,307	2,811	1,448
Total	47,387	49,842		53,081		56,325		59,566		62,801		66,043	

[a] MRI Boating Facility Inventory (berths/slips and moorings), MRI Technical Report No. 1.
[b] Gravity output from MRI Technical Report No. 2.

Table 3 - Growth Factor Matrix

Reach	Existing Utilization	1985	1995	2005	2015	2025	2035
R008	132	1.11	1.17	1.24	1.30	1.37	1.44
R007	2	8.00	8.50	9.00	9.50	10.00	10.50
R006	1,013	1.12	1.19	1.26	1.33	1.40	1.47
2005	2,362	1.26	1.34	1.42	1.51	1.59	1.67
2004	30	1.27	1.33	1.40	1.50	1.57	1.63
2003	2,127	1.18	1.27	1.36	1.44	1.53	1.61
2002	576	1.23	1.32	1.41	1.51	1.60	1.69
2001	622	1.13	1.21	1.30	1.39	1.48	1.57
R005	296	1.13	1.20	1.27	1.34	1.42	1.49
R004	1,935	1.08	1.14	1.20	1.27	1.33	1.40
3004	2,575	1.08	1.14	1.21	1.28	1.35	1.42
3003	7,560	1.00[a]	1.00[a]	1.02	1.08	1.13	1.19
3002	12,115	1.00[a]	1.00[a]	1.04	1.10	1.16	1.22
3001	2,578	1.18	1.26	1.33	1.41	1.49	1.56
R003	3,932	1.08	1.15	1.22	1.29	1.36	1.43
R002	8,169	1.11	1.18	1.25	1.32	1.40	1.47
R001	1,363	1.55	1.65	1.75	1.86	1.96	2.06
Total	47,387						

[a] Forecast utilization is less than 1979. Therefore, no growth (1.00) will occur in these reaches.

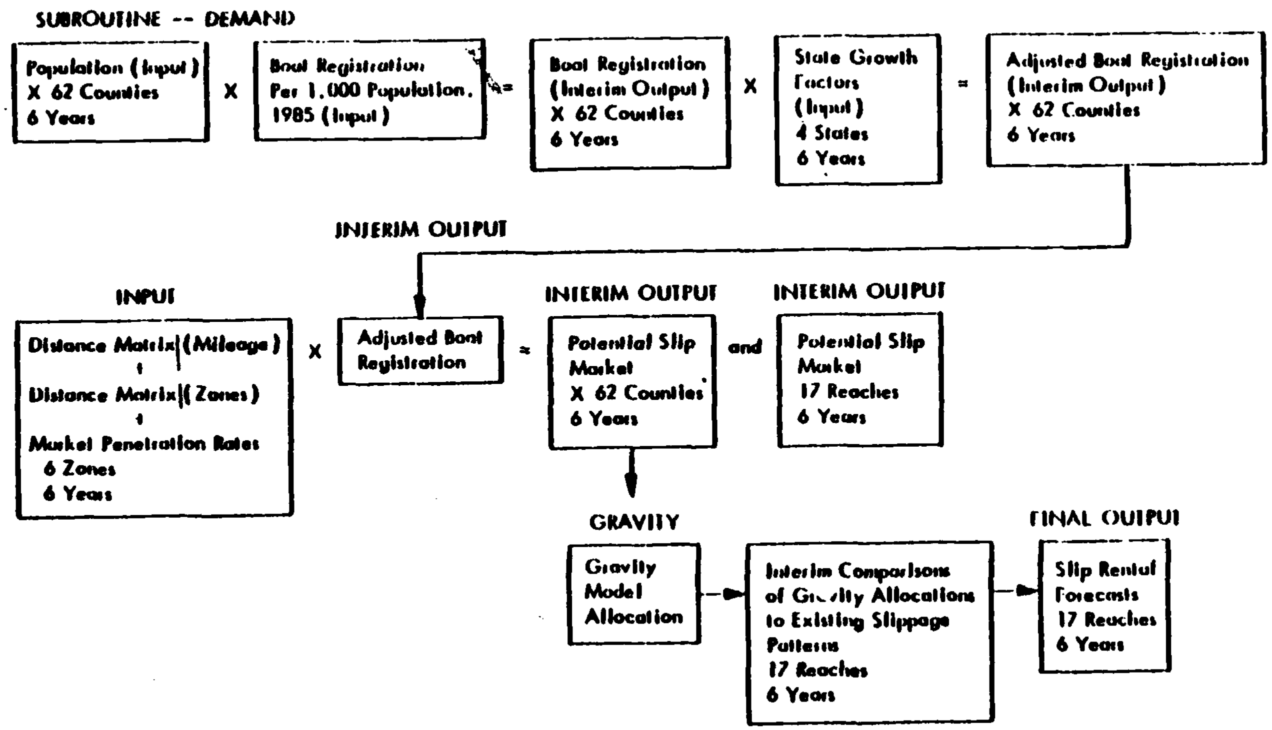

Figure 1 - Subroutine - Demand.

b. Allocation: The particular formation of the gravity model has been referred to by traffic planners as the "F-factor" form. The F-factor form of the gravity model is calibrated around trip productions to reproduce a trip distribution pattern similar to that provided by the interim potential slip market input. It is achieved in the following manner. Assumed values were used for the first set of F-factors, these values followed a somewhat smooth curve (assumed values were developed from the boating use survey data). As the gravity model was being calibrated, new F-factors were calculated for each model iteration by:

$$F(d)_{new} = F(D)_{old} \frac{\%\text{ of trips in }(d)_{new}}{\%\text{ of trips in }(d)_{old}}$$

where $F(d)_{old}$ is the F-factor of the previous iteration for the distance in question.

The relative size of the F-factors is of critical importance to the gravity model distribution. The distribution F-factors is affected by several factors:

- The demand for a given length trip as indicated by the trip length frequency distribution curve.
- The potential for having a given trip length.
- The interaction caused by competition with attractions at other lengths of trips.

It is difficult to use an areawide term to describe what will happen for individual counties in any model. The influence of one large trip interchange at a particular distance will affect all other trip interchanges at the same distance. The interaction caused by large trip interchanges will affect those of other distances also.

The calibration criteria center around two factors. One is the ratio of actual trip length to computed trip length by the model, and the second is the standard deviation of the ratios of percent of trips distributed to each distance band compared to the desired distribution. The model will continue to reiterate as presently programmed until the trip length ratio reaches a level of 1.7 and the standard deviation is reduced at 1.00.1/ At that time, the model prints a matrix that displays a number of potential slips being sought at each reach for all 62 counties.

1/ These constraints were empirically developed for the particular data used in this study. Normally the gravity model converges if the ratios are within 0.05 standard deviation. Because of the problem of using an areawide F-factor term to describe trip distribution patterns over a 1,000 mile stretch of lakes and rivers, however, quick convergence with this lower limit could not be achieved.

This process is repeated and reiterated until the criteria have been reached for all 6 forecast years. At the conclusion of the program, a final table is printed that shows the potential slip market demand for each of the 17 reaches for the 6 forecast years. Some of the basic inputs and outputs are described below:

4. Data input cards

a. Population forecasts:

Column	Contents
1-12	County Name
13-15	County Number
19-20	State Number
21-30	1985 Population
31-40	1995 Population
41-50	2005 Population
51-60	2015 Population
61-70	2025 Population
71-80	2035 Population

b. Present boat registration per 1,000 population (1979), projected to 1985:

Column	Contents
1-3	County Number
4-5	State Name
7-10	Boat Registration, 1,000 Population

c. Boat registration growth factors:

Column	Contents
1-2	State Number
7-10	1985 Growth Factor
17-20	1995 Growth Factor
27-30	2005 Growth Factor
37-40	2015 Growth Factor
47-50	2025 Growth Factor
51-60	2035 Growth Factor
61-80	State Name

d. Distance matrix (mileage):

Column	Contents
1-3	County Number
5-6	State Number
11-15	Distance from a County to Reaches
16-20, etc.	Continuing in Fields of 5.0 through Column 80 and from Column 11 through 25 on Card 2 for all other reaches

e. Distance matrix (zones):

Column	Contents
1-3	County Number
5-6	Column Number
10-37	Zone each reach falls in terms of distance from a county1/

f. Market penetration rates:

Column	Contents
1-4	Year (1985, 2005, 2015, 2025, and 2035)
6-10	Distance Band 1 (Percent of Market)
16-20	Distance Band 2 (Percent of Market)
26-30	Distance Band 3 (Percent of Market)
36-40	Distance Band 4 (Percent of Market)
46-50	Distance Band 5 (Percent of Market)
56-60	Distance Band 6 (Percent of Market)

g. Moorage capacity of pools:

Column	Contents
1-2	Reach Number
7-10	Capacity (distribution of wet berths/ slips and moorings, 1979--percent)
70	Must be "3"

1/ Zone Number	Mileage
1	0-25
2	26-50
3	51-75
4	76-99
5	100-150
6	150+

h. Friction factors:

Column	Contents
1-2	Distance (rounded to 10 miles) in sequence from 1 to 99
3-6	Friction Factors
70	Must be "5"

i. Trip length frequency factors:

Column	Contents
1-2	Distance (rounded to 10 miles) in sequence from 1-99
3-6	Percentage (same as friction factors)
70	Must be "6"

5. Gravity model outputs: Several interim outputs are provided by the program to give the user a cross-check on both data inputs and subsequent final output. These are described below:

a. Total boat registration: The resulting estimates of multiplying the 1979 per capita boat registration (projected to 1985) times population forecasts provide this interim output.

b. Adjusted boat registration: Applying the boat registration growth factors to the total boat registration provides this matrix. It is a matrix of 62 counties by the 6 forecast years.

c. Potential slip market: This interim output is provided in two forms. One is a matrix of 62 counties by 6 forecast years, and the second is a matrix of 17 reaches by 6 forecast years. It is the resulting interim output from multiplying penetration rates times the adjusted boat registration. The first table is the basic trip productions input that is allocated in the gravity model.

d. Comparison tables: Two basic comparison tables are provided as the model begins to reiterate the allocation process. The first table is a matrix of 17 reaches by the trips desired (slips and moorings) and the computed trips (slips and moorings) based on present moorage capacity. The computed trips are the model allocations. A third column provides a ratio between the two, and the fourth column provides a difference between computed and desired trips. At the end of three reiterations, a second table is output. For each distance zone, the final F-factor for the reiteration of the three tables is produced. A second column provides the trip length frequency factors; the third column produces the model trip length frequency results; the fourth column shows the ratio of the F-factors to the trip length frequency factors.

At the conclusion of this second table, the average trip length, the computed trip length, the ratio between the two and the mean and standard

deviation are produced. If the convergence criteria are not reached, the model goes through another set of reiterations. This process continues until the criteria are reached. At that time, yet another output is produced. It shows the number of trip productions, potential slip market generated for each separate reach by each county. The above process is repeated for each of the 6 forecast years for each of the 17 reaches.

6. Data for the Lake Erie regulation gravity analysis: Technical Report No. 7 contains the input data and interim and final outputs for the gravity analysis on Lakes Erie and Ontario and connecting waterways (17 reaches).

a. Input data:

- Population forecasts
- Distance matrix (mileage)
- Moorage capacity of reaches
- Friction factors
- Trip length frequency factors

b. Interim outputs:

- Boat registration
- Adjusted boat registration
- Potential slip market (counties)
- Potential slip market (reaches)

c. Final output:

- Potential slip market (17 reaches and 6 years) - six separate tables.

DATE

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